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EUCALYPTUS

BY

ABBOT KINNEY

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EUCALYPTUS

—BY—

ABBOT KINNEY.

AUTHOR OF

"Conquest of Death," "Tasks by Twilight," "Under the Shadow of the Dragon."
"Money," "Protection vs. Free Trade," "Australian Ballot,"
"Forestry," Etc.

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FOREWORD.

The planting of trees of various species of Eucalyptus in California has been carried on since January, 1856, when Mr. C. L. Reimer successfully introduced 14 species. During all this time neither nurserymen nor the general public have had any work on this genus by which they could identify the various species. Everything depended on the seedsmen primarily and in a secondary way on the accuracy of the records of planters. From mistake in both these respects the greatest confusion and uncertainty has arisen. Of the large number of useful species introduced into California but three or four are certainly and generally known today. The botanical works covering this genus are inaccessible to the public on account of their great cost. There are only three copies of the Eucalyptographia and two of Bentham's books in this State, as far as I know. The importance of this genus as producers of kino, oils, timber and fuel, for ornament and the reclamation of waste places and for the probable sanitary effects of several of the species together with the rapidity of growth of nearly all and the remarkable adaptability to the major portion of California makes a means of identification a want that should be supplied.

Baron Ferdinand Von Mueller has, in the broad spirit of a true scientific man, given me the use of his great work on this genus, even to copying the plates.

FOREWORD.

I have taken advantage of the courtesy of this distinguished man but the cost of using the plates would have defeated the main object I had in view, which is to make the knowledge of the Eucalyptus accessible to the largest possible number of enquirers.

I have also received very valuable aid from Mr. J. Ednie Brown, the prominent Australian Forester and botanist, and from Mr. Walter Gill, the present Forest Conservator of South Australia. The fine forest work in this colony under Messrs. Brown and Gill offers a wide field of knowledge to Eucalyptus planters.

Prof. A. J. McClatchie, of the Throop Polytechnic Institute of Pasadena, Cal., has given me specially valuable assistance, and I take pleasure in speaking of the important aid he has rendered in this work.

To many others I am much indebted for aid and information. Amongst them I may mention Hon. Thos. F. Bayard, now our ambassador to Great Britain, E. M. Shelton, Instructor in Argiculture, Queensland, Messrs. Scharf and Shorting, Pasadena, to Mr. Geo. S. Davis, publisher of the Bulletin of Pharmacy, Detroit, Mich., and to Prof. Tommasi Crudelei. Prof. J. H. Maiden, of Sydney, who is the authority on the chemistry of the Eucalyptus, has given me important help in various directions. Prof. B. E. Fernon, Chief of the Division of Forestry at Washington, has given me aid and comfort. The Rev. G. Montgomery, Bishop of Monterey and Los Angeles, assisted me in obtaining the original data of the Tre Fontane experiments for which I owe him much. Prof. S. M. Woodbridge, Ph. D., Hon. Elwood Cooper, Mrs. Jennie C. Carr, together with many more have rendered me valuable assistance. Both our own Federal and all foreign officials appealed to

have gone to much trouble and pains to promote my work. Two Secretaries of State, one Secretary of the Interior and several scientific men of the Department of Agriculture have, by their kindly help, demonstrated the public spirit of our high officers. It is difficult for a reader of this book to appreciate what this help has been. Sometimes two or three words in a line will represent voluminous and prolonged correspondence. Sometimes the result of a year's investigation is to leave some statement out entirely.

This work is arranged in two divisions. The first contains a popular account of the species of Eucalyptus introduced into California as far as known. The location of illustrative specimens is in each case indicated so that enquirers may readily see for themselves what the tree looks like. The second division will contain the special examination of points of interest in this genus including methods of planting, timber strength, the oils and kinos, the medicinal value, the sanitary influence, vernacular names and lists of species suited to different conditions of soil and climate. This division will also contain a condensed botanic description of all the species of Eucalyptus described by Baron Von Mueller and taken from his great work. A few notes regarding varieties and points noted in California will be added to this. To facilitate the use of these botanic descriptions there will be a key and an illustration of the typical anthers, magnified sixty times, prepared by Prof. McClatchie, of the four classes established by Von Mueller. I believe that the key, plate and descriptions will enable any intelligent person to identify the leading species of Eucalyptus. To complete this part of the plan there will be a botanic glossary.

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EUCALYPTUS.

GENERAL POINTS.

The Eucalyptus is a genus of hard wood, evergreen trees and shrubs. It belongs to the order Myrtaceæ and to the tribe Leptospermeæ. The name was suggested by the lid or cap-like covering over the immature flower. It is from the Greek and may be translated "well hidden." This genus was discovered and described first by L'Heritier, in 1788; who based it on the species "obliqua." The blue gum was discovered ten years later by Labilliardière, who described Eucalyptus cornuta at the same time. In 1806 Labilliardière described two other of the more valuable species, viz: Eucalyptus viminalis and Eucalyptus amygdalina. It is said that so large were the trees of the blue gum first seen by Labilliardière in Tasmania, that he could ascertain that they were in flower only by his telescope. The flowers were brought down after prolonged firing at the upper branches with guns. Labilliardière says in his own notes that he obtained the flowers and fruit by chopping down a tree.

The genus just escaped being called Aromandendrum. This name was given by Dr. Wm. Anderson, who described it independently when with Cook's second voyage

of discovery. Baron Von Mueller, coming into this field late, has described and named more species than any one person; in fact he is now the recognized authority on this genus. Anyone desiring to study the Eucalyptus should by all means procure Baron Ferdinand Von Mueller's Eucalyptographia, together with his other numerous works on the genus. Bentham's Flora Australiensis is reliable. The splendid work commenced by J. Ednie Brown on the Forest Flora of South Australia is in folio size and contains colored plates of each tree described. This work unfortunately was never finished. Prof. J. H. Maiden's "useful native plants of Australia" contains valuable information on the kinos, oils and timbers of the genus. Many valuable and interesting articles on the Eucalyptus are scattered about in scientific journals or in monographs practically inaccessible to us in California. Bentham's and Von Mueller's works are expensive. Most of the popular and many of the scientific monographs on these valuable trees and their products are out of print, and a considerable percentage are in French, and a few in Italian and Spanish. It seems useful, therefore, to bring some of this scattered information together in this work. To it I have added our Californian experiences. Indeed, it is especially to furnish a popular statement of facts for Californian use that I have undertaken this monograph on the Eucalyptus.

The first great acclimatizer and Eucalyptus missionary was M. P. Ramel. This gentleman was so struck with the extraordinary qualities of this genus while at Melbourne, in 1854, that he started a crusade in its favor. Planchon calls Von Mueller the prophet and Ramel the apostle of the Eucalyptus. The first Eucalyptus tree known to have grown outdoors in Europe is said to have

been planted at Hyères, in the South of France, in 1857. In 1875 this tree was 20 metres high, the trunk 1 metre from the soil was 2 metres 10 centimetres in circumference.

Certainly Ramel's enthusiasm for the Eucalyptus is well justified.

The highest monument in Europe, for instance, is 460 feet high, while the tallest Eucalyptus is 480 feet high.

Eucalyptus trees had, even in 1854, been planted by different gardeners in Europe, and at least one, by M. Hardy, in Algiers; but he did not know the tree until 1863, two years after the Hamma and Cordier plantations in that African province.

It was first called Eucalyptus glauca in Europe (Eucalyptus globulus) when grown from seed.

The Eucalyptus was introduced into this State in 1856. Hon. Ellwood Cooper, of Santa Barbara, has been probably the most active agent in bringing Californians to a knowledge of the Eucalyptus. Col. Warren of the California *Farmer*, Mrs. Jeanne C. Carr and General Stratton were also very active and enthusiastic as apostles of these trees on the Pacific Coast. It seems indeed regrettable that the work of Prof. and Mrs. Carr, at and about our University, in planting should be today so little available through the loss of the records.

The genus contains about 150 species, rather less than more, and the number is still not fully settled. This is on account of the doubt of the specific value of some now ranked as varieties and of others now ranked as species, and also on account of the incomplete study of the tropic flora of Australia, New Guinea, Timor and the Moluccas. If we consider the island of Tasmania as a part of Australia there are about five species of Euca-

lyptus found outside of that continent and all of these in the adjacent islands of New Guinea and Timor, and one only in the Moluccas. There is not a single species found in New Zealand. It seems indeed strange that the most adaptable of all forest trees to the semi-tropic world belt should be derived from so confined a genus. Besides this the most friendly to new conditions of all its species is one naturally limited to the damp gorges of Tasmania and Victoria. At least twenty important species of Eucalyptus have a wider Australian range than Eucalyptus globulus or the common blue gum. Still it is the blue gum that has been found thus far the best suited as a tree for other countries and wide ranges of soil and moisture. In California when any one speaks of Eucalyptus trees in a general way the blue gum is meant. By this we may judge how completely our Eucalyptus plantations are dominated by this species.

The blue gum is a remarkable tree. It is about third as to height in the genus, being surpassed only by E. amygdalina and Eucalyptus diversicolor. The tallest blue gum measured was found in Tasmania and was 330 feet in height. Numbers have been measured over 250 feet, and a height of even 400 feet is claimed for it. In this matter of height measurement Von Mueller calls attention to the fact that extreme height in the Eucalyptus is due to long slim branches reaching skyward. In this respect it is quite different from the great stems of timber of our pines and Sequoias which have only very short vertical branches. Those of an ultra patriotic humor may still claim that for tree height of solid stem and for cubic wood contents our Sequoias lead the world. In dry, open plains it is not likely that blue gums will grow to be very tall. In fact

there are few in California over 150 feet high. If, however, some were planted in any of the burned and desolated redwood coast canyons of California where the conditions of moisture and exposure are similar to those in its native haunts we might reasonably expect to see blue gum trees eventually as tall as any in Australia. In its native haunts the blue gum is often, nay, generally, exposed to light frosts. Some very observant planters in the warmer parts of New South Wales state that the Eucalyptus globulus is never a long lived and really successful tree unless subjected to occasional nipping airs. Other authorities, however claim successful experiments in tropical highlands with this species, locations probably free from frost. But such reports are only made from tropical sections with a heavy rainfall. The tree has failed in Arizona and Texas. But, in those places, its failure is due, doubtless, to excessive frost on the one hand, and prolonged excessive heat on the other.

Mr. J. Ednie Brown and Mr. Walter Gill both found the blue gum unsuited to their interior plains (South Australia) generally similar in dryness and heat to our interior valleys. We have fully confirmed their experience except where the subsoil is moist.

In Arizona even this condition fails, apparently, to reconcile them to the prolonged heats of that section

In Australia Eucalyptus leucoxylon, Eucalyptus corynocalyx and Eucalyptus polyanthema seem specially suited to sections too dry for the blue gum, and Eucalyptus rostrata for air too dry and hot and frosts too severe.

The blue gum is the fastest growing tree in the world. There are, indeed, trees that for a short time, or under special conditions, grow as fast as the blue gum. In fact, in the damp Vitorian gorges the variety regnans of

Eucalyptus amygdalina is reported to grow faster than any wood-making plant. Nothing in our experience with regnans shows it to be a fast growing plant. So also, in experiments at and near Santa Monica we have found several species growing for a short time in that situation as fast as the blue gum. Of these experiments we may mention a Eucalyptus viminalis (Manna-gum) that, nineteen months from the seed, and fourteen months from the transplanting, without cultivation, on a side hill, grew fourteen feet six and three-fourths inches. A Eucalyptus corynocalyx (sugar gum) of the same age and in the same place grew only one-fourth of an inch less. I have seen an E. Gunnii for the first two or three years, grow faster than a blue gum by its side. But taking dry and wet canyon and plain the blue gum will exceed in growth any tree in the long run.

Some of the records are as follows:

GROWTH OF E. GLOBULUS.

Malaga, Spain, 6 yrs. - - - - - - - -	65 feet
Nielgherry hills, India, 18 mos. from seed,	20 to 25 feet
Lago Maggiore, Italy, 9 years, - - - -	60 feet
Nice, France, 5 years, - - - - - - -	50 feet
Kinneloa, California, 8 years, - - - - -	71 feet

Experimental plantation of trees reported on by J. Ednie Brown, Conservator of Forests, S. Australia, showing comparative rate of growth of different trees similarly situated.

PLANTATION C.

Height, Age and Girth of Trees.

Date of Planting	Name	Age	Height	Girth 2 ft. from ground
		years	ft. in.	ft. in.
1880	Pinis insignis	6	40 0	2 4
"	" "	6	30 0	1 7
"	" "	6	33 8	2 0
"	" pinaster	6	17 0	1 2
"	" halepensis	6	15 0	1 7
"	Eucalyptus globulus	6	42 0	2 9
"	" longifolia	6	25 0	1 8
"	" oblique (Tasmanian Stringybark)	6	22 8	2 0
"	" diversicolor (karri)	6	27 0	2 0
"	" " "	6	33 6	1 6
"	" siderophloia (Ironbark)	6	18 0	1 8
"	Melia azedarach	6	14 10	1 7
"	Eucalyptus cornuta	6	30 0	2 0
"	" obliqua (South Australian Strtngybark)	6	23 8	1 5
"	Pinus insignis	6	26 0	2 0
"	" "	6	27 6	2 0
"	*Eucalyptus globulus	6	45 0	2 3
"	" "	6	45 0	2 5
"	" "	6	47 0	2 1
"	" "	6	60 0	2 0
"	" "	6	58 0	2 9
"	" longifolia	6	35 0	0 11
"	" "	6	35 6	1 2
"	" "	6	37 0	1 2
"	" siderophloia	6	24 0	1 10
"	" "	6	30 0	1 10
"	" obliqua (South Australian Stringybark)	6	20 6	0 10
"	" " "	6	20 0	0 10
"	" " "	6	22 0	0 9
"	" corynocalyx	6	26 0	1 2
"	" "	6	29 6	1 7
"	" "	6	30 0	1 6
"	" "	6	25 8	1 2
"	" cornuta	6	23 3	1 0
"	" "	6	23 0	1 2
"	" "	6	33 0	1 6
"	†Catalpa speciosa	6	25 6	1 2
"	" "	6	25 0	1 6
"	‡Fraxinus Americana	6	21 8	1 5
"	" "	6	24 6	1 5
1878	‖Walnut	8	20 0	1 6
"	"	8	24 0	1 10
1881	Wattles (Acacia pycnantha)	5	16 0	0 9
"	" " "	5	18 0	0 8
"	" " "	5	19 0	0 9
"	" " "	5	15 0	0 6
"	" (small tree measurements)	5	12 0	0 6½
"	" "	5	12 0	0 5
"	" "	5	12 0	0 5½
"	" "	5	12 0	0 7
1880	Cupressus sempervirens	6	24 0	1 1
"	" "	6	22 0	1 2

* Numbers averaging 40ft., and girthing from 1ft. 6in. to 2ft. 3in † Averaging 20ft. and 1ft. girth in best land. ‡ Averaging 20ft. and 15in. in moist land. ‖ Averaging 20ft. and 15in. in girth, and in good bearing.

Measurements taken September 1st, 1886.

Plantation E.

Height, Age and Girth of Trees.

Date of Plant-ing	Name of Tree	Age	Height	Girth at 2ft. Height
		years	ft. in.	ft. in.
1881	*Eucalyptus viminalis	5	27 0	1 1
"	" "	5	30 0	1 0
1881	Eucalyptus globulus	5	40 0	1 6
"	" "	5	41 0	2 0
1881	Eucalyptus corynocalyx	5	28 0	1 5
"	" "	5	27 0	1 2
1881	Pinus maritima or pinaster	5	11 0	0 9
"	" "	5	14 0	1 0
1881	†Pinus insignis	5	25 0	1 4
"	" "	5	24 0	1 4
1882	" "	4	25 0	1 2
"	" "	4	24 6	1 1
"	" "	4	21 0	1 1
"	" "	4	24 0	0 11
"	" "	4	22 0	1 0
"	" "	4	23 0	1 0
"	" "	4	28 0	1 1
1882	‡Pinus maritima	4	14 0	0 7
"	" "	4	13 6	0 6

*Numbers of these 20ft. in height. †A great number from 17ft. to 20ft. high.
Measurement taken August 31st, 1886. *Height.*

Height, Age and Girth of Trees at White Park.

Date of Plant-ing	Name of Tree	Age	Height	Girth 2ft. Height
		years	ft. in.	ft. in.
	PLANTATION G.			
1883	Pinus radiata	3	17 0	1 1
"	" maritima	3	7 0	0 7
"	" insignis	3	16 0	1 2
"	Eucalyptus viminalis	3	26 0	2 0
"	" globulus	3	20 0	1 1
"	" leucoxylon	3	19 0	1 11
"	" corynocalyx	3	17 0	1 0
"	" gomphocephala	3	17 0	1 1
	PLANTATION I.			
1884	Quercus pedunculata	2	7 0	0 5
"	Catalpa speciosa	2	6 0	0 4
"	Populus fastigita	2	12 0	0 6
"	Ulmus suberosa	2	9 0	0 4
"	Eucalyptus leucoxylon	2	9 0	0 7
"	" corynocalyn	2	13 0	0 11
"	" viminalis	2	11 0	0 7
"	Pinus insignis	2	8 0	0 7
"	" maritima	2	3to4 0	—
	PLANTATION J.			
1885	Eucalyptus corynocalyx	1	7 0	0 4
"	" viminalis	1	4to5 0	—

Experimental plantation of trees at Santa Monica made by W. S. Lyon, Forester to the California State Board of Forestry.

NAMES.	Tract A.		Tract B.		Remarks.
	Best.	Average.	Best	Average.	
1. Eucalyptus polyanthema (Many-Flowered Gum)........................	9.6	7	4 2	3 6	........................Growth in B small but thrifty.
2. Eucalyptus globulus (Tasmanian Blue Gum......	4.6	4	....	....	......None planted in B
3. Eucalyptus cornuta.......................	7	6	4 6	4	......Sent out last year as the "Tooart Gum," remarkably thrifty in both plantations.
4. Eucalyptus obliqua (Stringy Bark or Messmate...............................	6	5.6	2	0	............Moribund in B. Lacks good color in A.
5. Eucalyptus leucoxylon (Victorian Iron Bark..................................	5	4 6	5 6	4.6	..............Richer, better color in the iron soil.
6. Eucalyptus rostrata (Red Gum)....	....	....	5.6	5	.........Not planted in A.
7. Eucalyptus corynocalyx (Sugar Gum)...	6	5.6	....	....	.........Not planted in B.
8. Eucalyptus viminalis (Manna Gum)...	6 6	5.6	5.6	4 6	........."Off" color in B.
9. Eccalyptus Stuartiana (Apple-Scented Gum)............................	6.6	4 6	....	....	.........Not planted in B.
10. Acacia mollissima (Soft Leaf Wattle).......................................	6	5	....	....	.........Not planted in B.
11. Acacia pycnantha (Golden Wattle)...........	3 6	3	3	2.6	.........................Strongly vigorous in both.
12. Acacia melanoxylon (Blackwood)..	2	0	0	0	Sickly in A. Dead in B.

Analysis of Soil in Tracts.

	Tract A.	Tract B.
Insoluble matter... ..	49.948	48.570
Soluble silica...	20.730	8.245
Potash (K_2O)	1 093	1.537
Soda (N_2O)...	.658	.853
Lime (CaO)...	3.227	8.143
Magnesia (MgO)..	2.855	2.450
Br. ox. manganese (Mr_2O_4)...........................	.048	.020
Peroxide of iron (Fe_2O_3).............................	8.109	18.193
Alumina (Al_2O_3)...	6.774	1.509
Phosphoric acid (P_2O_5)................................	.228	.280
Sulphuric acid (SO_3)......................................	2.648	.733
Carbonic acid (CO_2)......................................	....	3.180
Water and organic matter............................	3.597	6.370
Totals..	98.913	100.89

Report of Byron O. Clark, Eucalyptus sideroxydon, (Eucalyptus leucoxylon) on the side of a zanja at Anahiem. Cut when 4½ years old. Height 71 feet.

In Dr. Aber's plantations on the Rio de La Plata, Argentine the Karri, Eucalyptus diversicolor, grew fastest and Eucalyptus corymbosa ranked with blue gum.

At from ten to twelve years of age the blue gum in California ceases to maintain its phenomenal fast growth. The other species cease their fast growth, as a general rule, some years sooner. In this matter some ratio seems to exist between the duration of rapid growth and the eventual height of the tree.

The blue gum is like all the valuable species of Eucalyptus in not being able to stand prolonged or very heavy frost. What it will stand depends something on the humidity, the condition of the tree as to sap flow and the age of the tree. Old trees have withstood a temperature of 15° F. without material injury. Young trees will, however, stand no such temperature. A minimum temperature of 24° may be deemed safe. Von Mueller has noted the blue gum shoots on giant trees along the Dandenong range in Victoria, frost burned, and has also noted these trees covered with snow for long periods without injury. In California, one species of our indigenous Rhus of the disagreeable smelling leaf, what we call the evergreen sumac, is often frost burned in its native haunts. So in the blue gum and the sumac we find imperfect adaptation to their present native conditions, due perhaps to a changing climate.

This year we have had, in Southern California, nights colder than usual, that is, temperatures that occur once or twice in a decade. After these cold nights I visited two sandy washes along the foot hills, in one of which were 2

year old small sugar gums (Eucalyptus corynocalyx) out one year, and in the other some yearling blue gums and many older, but stunted trees. In both washes the native sumac was frosted, and in nearly every case the whole foliage killed. The sugar gums were not all touched, but nearly all had the outer top leaves frost burned. Hardly any of the young blue gums were touched and these only very lightly. However, the young blue gums were among the older trees and doubtlessly received some protection.

Our common Rhus is comparatively rare along the coast further south, and another ornamental and very attractive Rhus, well worthy of gardeners' attention, takes its place. This latter, rare here, has not been frosted at all this year. This seems rather a strange thing, a southern type to be so resistant.

I am quite convinced that we could obtain a more reliable frost resistance in the blue gum by a careful gathering of seeds from trees thriving in the coldest places to which this species is indigenous. Although the native habitat of the blue gum is restricted, it still is subject to a considerable climatic range. Both in Victoria and Tasmania it climbs well into the mountain valleys, and it seems only reasonable that seed from some of the more exposed trees would resist more cold than those on the warm mesas. The seeds of all other plants are eventually impressed by the climates in which they are produced. This fact is availed of by agriculturists in vegetables, grains, etc. We know also that certain tree seeds all of the same species produce plants of different capacities in resisting cold on one side and heat and drought on the other. Take, for instance, the Douglass spruce indigenous from British Columbia to the Mexican line. Seeds of this spruce show great variations

in the resistance of the trees they produce to unfavorable climatic conditions, and these variations correspond with the climatic conditions where the seed produced grew.

It seems only resonable to presume that this quality would extend also to the seeds of the blue gum. Our California plantations of blue gum are now practically all made from locally gathered seeds.

Doubtless, too, the prevalence of conditions, such as prolonged drought, whereby the tree remains dormant during the periods of exposure, would prove favorable to resistance of frost. The vegetable world, in this respect, is the opposite of the animal. There are indeed hibernating animals that remain dormant during the winter, living on themselves, but no animal can resist extreme cold so well with diminished as with active circulation. In the vegetable world the opposite condition prevails.

Animals suffer most from cold when exposed to wind. With plants it is exactly the reverse. At least such is the fact in the semi-tropics. A breeze on a cold night is considered a protection against frost. It is a wise precaution to discourage active sap circulation in delicate plants as periods of possible frosts approach. In irrigated sections this may be done by withholding water in the fall.

As the young Eucalyptus is more susceptible than the old to frost so we find numerous sections where this tree does well if the young are protected with straw, gunny-sacks or any light covering; indeed just as young orange and lemon trees are in some of our interior plateaus. In these sections the citrus fruits are a success, but every now and again a great deal of snow falls in the neighboring mountains and the night air descending to the valleys is colder than usual. When to this condition we have added

a dry still atmosphere the rapid radiation causes frosts severe enough to seriously injure and even kill young citrus trees. The shortness of the young trees is one element of their danger. The nearer the ground the greater the danger. One writer says that the climatic range of the orange tree is that of the blue gum and where one will grow so will the other. In contradiction to this, reports to me from Arizona mention citrus trees as successful and Eucalyptus a failure. In this case however it is said to be the prolonged dry heat that unfavorably affects the Eucalyptus (Eucalyptus globulus.) On the other hand the blue gum thrives remarkably in the damp cool climate of the California coast where the orange is a sad failure. About the Southern confines of Los Angeles city where the blue gum is in superb health and has a great development the orange tree also thrives but gives an inferior fruit with excess of acidity.

I think that the orange and blue gum will resist about the same degree of frost.

It should not be forgotten that water is an equalizer of temperature and helps frost resistance. Therefore if a frost threatens, a full flooding irrigation will diminish the danger.

In a Washington, D. C., nursery there is a Eucalyptus, species unknown, that for a number of years has been frozen every winter, but which sprouts anew each spring. In Paris the blue gum is sometimes used for ornament in the parks. The way this is done is to plant the seed in the open, transplant it to hot-house for winter, and set out the second summer, leaving it to its fate in the succeeding winter.

In Australia the numerous species of Eucalyptus have

an extraordinary reported capacity of varying according to the soil and climate which they occupy. Some species have persistent bark in one geological formation and shed their bark in another. Some have green leaves, horizontal and broad near the coast and sickle shaped gray ones hanging vertical in the interior. The same species often vary, even in the color of their flowers. A number vary in the essential oils and odor of their foliage, and all are affected in the character and quality of their timber by situation and climate. The forest trees indigenous to California have also often a strong tendency to vary, and again, like some Australian species, many of our trees are indigenous to very narrow limits. The Brewer, or beautiful weeping spruce, the Foxtail Balfour pine, the Torrey pine, the Lawson and Monterey Cypress, are amongst those so confined. One of our pines, the Monterey, *P. insignis*, the fastest growing pine in the world, and more largely planted in Australia than any foreign tree, has a very restricted natural range about Monterey. We have in this pine some counterpart to the blue gums.

First—That it renders soil, air and water aseptic.

Second—That it is the most adaptable of our coniferous trees.

Third—That it is of so confined a natural habitat.

Fourth—That other trees about it of very wide range like the Douglas spruce do not succeed in our plantations anything like so well.

So the blue gum of naturally restricted range succeeds better in plantations than very widely distributed Eucalyptus like, for instance, Eucalyptus rostrata, found in every division of Australia proper and absent only in Tasmania

The Monterey pine is a better tree than the blue gum.

for cold places, and on the blue gums' limit of temperature it is better for all sandy places and especially better for beaches exposed to sea winds. The Monterey pine, however, is not a valuable timber tree nor a good fuel one. Its uses are to hide scars, cover waste places, stop sand drift and look as handsome as a young pine can. It stands cutting and breaking better than any pine with which I am familiar. I know of one case where it sprouted from a blown over tree and grew well. The main tree was not cut off until the sprout had started.

Mr. L. Stengel, an experienced and careful nurseryman, is of opinion that Eucalyptus has a strong tendency to hybridize. There is just now a demand for Eucalyptus robusta (swamp mahogany). In preparing for this Mr. Stengel gathered robusta seed from four handsome specimens on Downey avenue, East Los Angeles. Recently while visiting his nursery Mr. Stengel showed me the results of his seed planting. The vast majority were true to the parent tree, but many in his large planting varied very widely from Eucalyptus robusta. One specimen was identical with globulus, several were like amygdalina var-regnans; in fact about fifteen distinct species apparently came from these robusta seed. If hybridization be accepted as the cause of these nursery results, we may account for some of the truly extraordinary surprises Australian Eucalyptus seeds have given us. I have personally known seed from the collection of Baron von Mueller, and forwarded most kindly by him, come up in form quite foreign to the tree as described by him. I believe that every Californian experimenter in Eucalyptus has had a similar experience with Eucalyptus seeds.

Mr. Scharf, of Pasadena, who has taken a great interest

in introducing new species of Eucalyptus, has a number of sketches in color of the flowers of the ornamental Eucalyptus ficifolia, introduced for its brilliant red flowers. These sketches were largely of flowers from trees growing from seed gathered by himself from Eucalyptus ficifolia in his own nursery. The difference in the colors is radical, from pale orange yellow to deep red. The foliage in these ficifolias also varies greatly.

I am, however, not ready to accept these results as due to hybridization. Natural variation under new conditions and careless seed handling must be considered in the solution. Stengel's robusta is not the true robusta but a variety.

The blue gum is the best all round tree within its climatic range. It makes fire wood and timber fast; growing rapidly into an effective wind-break, contains a large amount of essential oil in its foliage; its leaves are amongst the most efficient agents in cleaning out the incrustation of boilers. It is available for the medicinal preparation of Eucalyptol and is altogether the best tree for any considerable range of condition in semi-tropic climates as far as now known. The introduction of this tree has done more to change radically the appearance of wide ranges of country in California than any other one thing. In the reclamation of many arid plains of the central and southern parts of California the blue gum has worked almost like magic. It modifies the winds, breaks the lines of view all so quickly that one can scarcely realize that a valley of clustered woods and lines of trees was but a year or two before a brown parched expanse of shadeless summer dust. I do not think that the power of the blue gum in modifying the appearance of a country can

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be appreciated by any one who has not seen some stretch of country before and after its introduction.

The seedling of the blue gum possesses a peculiarity general to the genus. It does not look in the least like the grown tree. The seedling varies as a plant as much from the mature tree as do some insects in the larval state from their mature form. The blue gum seedling has a sharply square stem and branches, leaves opposite, sessile, round, and horizontal to the branch. Occasionally the young stem is six-sided and in this case the leaves and stipules spring in threes, each group from alternate sides. These early square or six-sided stems are so winged as to resemble the bottom of a Sonoma snow shoe or the under side of a skate runner. It is colored bright gendarme blue, both in stems and leaves, with an appearance of being slightly dusted with flour. The mature tree has round stems and branches, with white bark or tan brown just before the outer part is shed, the leaves are sickle-shaped, alternate with long stems, hang edgewise to the sky, and they vary from a dark and often glossy green to a dull gray color.

This surprising difference between the seedling and the more aged tree, caused several botanists in Europe to set up a new species from the seedlings first raised in their hot houses.

In nearly every considerable plantation of blue gums will be found a few specimens of what appears to be a reversion to a more primitive type. This sort is usually in the form of a bush with numerous stems, though exceptionally with but one, and foliage of the yearling gum that is to say, opposite, oval, sessile and blue, tending to persist longer than in the regular globulus. It is quite

ornamental. E. cordata is a dwarf Tasmanian species, that maintains through life this opposite, oval and sessile foliage. When a blue gum is pollarded, or cut back, the new sprouts always have at first the seedling or yearling foliage in a dense mass of oval leaves, blue as a gendarme blue can be.

In very dry places, or after continued cool weather, the young blue gum foliage may be seen to vary in an extraordinary way. At times the whole tree will have a pink sheen in its blue foliage, again the under veining of the leaves will be bright crimson, and sometimes the square stems will change from their peculiarly assertive blue to the crimson of the leaf veins. A few leaves, too, will turn red, as red as any eastern Autumn leaf. Yet the general blue aspect will not be lost. In the older trees the young stems of the ultimate sickle-shaped leaves are usually a lemon yellow, but sometimes are a dull red. The branchlets are more often red, in fact, generally these are red and only the youngest shoots are yellow.

I have spoken of Eucalyptus globulus seedling foliage as gendarme blue. This, however, is not exact. The color is a sort of silvery grey done in blue. It is bluer than the leaf of a century plant, but of that type of color. The foliage of the old trees, it must be remembered, is of an entirely different color. While the blue gum is not a desert plant, it has been most planted in countries that have a natural tendency in that direction, and is well fitted at least for the outskirts of the arid districts. Its first color suggests the frequency of blue shades, in the foliage of plants subjected to such conditions. In the dry portions of California we have many blue foliaged plants, cactus, yucca, many of the artemesia, manzanita, and in trees,

several pines and oaks. Both the Quercus Douglassi and Q. Engelmanii are bluish and often quite blue. Nearly all our scrub oaks are blueish gray. In pines, P. Sabiniana is our ugly blue-grey foothill pine, P. Torreyana and P. Parryana blueish grey, and there are several others. The pines in many cases have the blue gum characteristic of having the seedlings bluer than the mature tree.

The blue-grey foliage, so frequent in the Eucalypti, is not accompanied by blue flowers. The genus Eucalyptus has red, white and yellow, but no blue flowers, the same range of color, in fact, as the rose. The Eucalyptus flowers, as a rule, are handsome and decorative, but difficult to handle as cut flowers.

The three colors, red, blue and yellow, in their purity, have an antipathy to union in one genus of plants. Any two may be found together in kinds of flowers, but the three in full character are not. Exceptions to this are claimed, as in the Hyacinth. With this beautiful flower the reds and blues are distinct enough, but the claimed yellow is usually a dirty dull color, verging to red. Whether a few exceptions exist or not, to the rule, the general refusal of all these three colors to occur in the flowers of any one genus of plants, is worthy of more attention and investigation than it has received. With this rule in mind, the blue foliage of the Eucalyptus without the blue flowers, becomes a matter of much more interest.

One of the advantages of the blue gum is the small size of the seeds, their reliable fertility and excellent keeping powers. In an ounce of well sifted blue gum seeds there will be 10,000 fertile grains. The sizes of the seeds of the noted species of the Eucalyptus are as follows:

SIZE OF EUCALYPTUS SEEDS.

The proportionate as well as absolute size of the fertile and sterile seeds is at an average so different in many Eucalyptus, as to afford often important marks of specific distinctions. The subjoined notes of measurement may thus aid not only in recognizing species scientifically, but also in controlling to some extent the purchase of seeds of particular kinds in the trade.—(VON MUELLER.)

Eucalyptus rostrata: fertile seeds ⅜ to ½ line long, about ⅜ line broad, sterile seeds ½ to ¾ line long, about ¼ line broad;—E. polyanthema, E. melliodora, E. paniculata, E. hemiphloia: fertile seeds ½ to ¾ line long, about ½ line broad, sterile seeds about ⅓ line long, ⅙ to ¼ line broad;—E. goniocalyx, E. cornuta, E. Gunnii, E. Sturtiana, E. tereticornis, E. botryoides, E. siderophloia, E. cinerea, E. Leucoxylon: fertile seeds ¾ to 1 line long, ½ to ¾ line broad, sterile ½ to ¾ line long, about ¼ line broad; E. amygdalina: fertile seeds ⅔ to 1 line long, ½ to ⅔ line broad, sterile seeds ½ to ¾ line long, ⅜ to ½ line broad;—E. hæmastoma: fertile seeds ¾ to 1 line long, about ¾ line broad, sterile seeds about ¾ line long, ½ line broad;—E. obliqua, E. macrorrhyncha, E. pauciflora, E. Sieberiana: fertile seeds 1 to 1½ lines long, ¾ to 1 line broad, sterile seeds ¾ to 1 line long, ½ to ¾ line broad;—E. cosmophylla: fertile seeds ¾ to 1 line long, about ¾ line broad, sterile seeds ¾ to 1½ lines long, ⅓ line broad;—E. gomphocephala: fertile seeds 1 to 1½ lines long, ¾ to 1 line broad, sterile seeds 1 to 1½ lines long, ⅓ to ½ line broad;—E. globulus: fertile seeds 1 to 1½ lines long, ¾ to 1 line broad, sterile seeds 1 to 1½ inches long, about ⅓ line broad;—E. megacarpa;

fertile seeds 1 to 1½ lines long, ¾ to 1 line broad, sterile seeds 1 to 1½ lines long, ½ to ¾ lines broad;—E. marginata, E. buprestium: fertile seeds 2 to 3 lines long, 1 to 2 lines broad, sterile seeds 1¼ to 2 lines long, ¾ to 1¼ lines broad;—E. Abergiana: fertile seeds with their membranous appendage 3½ to 5 lines long, 1½ to 2 lines broad, sterile seeds 1½ to 3 lines long, ½ to ⅔ line broad;—E. calophylla: fertile seeds 6 to 9 lines long, 3 to 4 lines broad, sterile seeds 2½ to 4 lines long, 1 to 1½ lines broad.

The seed cases or fruit of the blue gum, in some places, change color after they fall. I have several times made collections of them at Santa Monica to enjoy the brilliant and beautiful shadings of color that these assume and for a considerable time maintain.

The Eucalyptus flowers have no ornamental petals. Their form and coloring depend on the numerous stamens. Most of them look like beautiful pompons. The blue gum flowers are decorative and striking, especially when naturally surrounded with the sickle-shaped leaves. These flowers have the filaments white, and the anthers a delicate cream yellow. The general appearance is white.

The stem, as has been said, is deeply grooved on the four sides in the young square stage. Upon this the opposite sessile leaves are placed in pairs, alternately springing from one side of the square and then from the other. The stem often, however, has a spiral twist, in which case the alternate effect of this placing is lost.

In this young stage a small stipule accompanies each leaf. Quite often this stipule grows and branches out, and founds new branches.

The smaller seeds of the Eucalyptus when carefully

kept retain their vitality for four years at least. While even the very small amygdalina seed are recorded as all fertile six years after gathering, experimenters have had too many sad experiences in California with worthless Eucalyptus seed to trust to any but the freshest. Several Australian authorities state that the majority of Eucalyptus seeds are sterile. This has not been my experience.

Amongst the Eucalypti there seems to exist a rule that the size of the seed shall be inverse to the size of the plant. Thus, about the smallest seeds are those of the amygdalina, the tallest of the genus, while the largest are on far smaller trees or even bushes like the Eucalyptus miniata. A seed of this very ornamental crimson flowered species was planted after being for thirteen years in the museum at Melbourne and promptly sprouted. This indicates a seed vitality that is a frequent characteristic of plants indigenous to countries with prolonged dry seasons. In the contrast of the size of seeds to the size of the trees bearing them California has a parallel for Australia. Our Sequoia is our largest tree and its seeds are very small while our dwarf pines and mesquite have pretty good sized ones.

I have alluded to disappointments due to sterile Eucalyptus seeds but troubles from this source are slight compared to those arising from fertile seed not true to name. To such an extent has this unreliability of seed gone that even so important a species as Eucalyptus rostrata, (red gum,) is still represented in our plantations by half a dozen different species.

This confusion has been attributed to the carelessness or even fraud of the seed sellers. My own opinion is that it is more due to ignorance and mistake than to anything

else. One of my most reliable correspondents in years gone by has sent me seed marked Eucalyptus polyanthema, which turned out to be Eucalyptus Gunnii, and packages of Eucalyptus rostrata that in one case contained six different species of Eucalyptus. Perhaps the hybridization already alluded to is the real solution of our surprises. On the other hand carefully collected seed by an experienced man under my orders showed all the seedlings true to the parent tree. This was our experience with a number of species.

The common substitute for the red gum and the species most generally planted for it in California has been Eucalyptus viminalis, also a useful tree but not valuable like the others for lumber. While this tree is radically different from the red gum there is an extensive district in Australia where the mature trees of these generally dissimilar species are said to appear much alike. A person in such a district shown a true red gum might easily mistake a manna gum in another location for it.

The utility of these two species is absolutely different, therefore the mistake in confusing the manna with the red is the more to be regretted. Every old plantation that I have visited in California, except at Elwood, reputed as red gum has turned out to be either viminalis or a tree entirely different from either—E. occidentalis. This latter is a very valuable timber tree and well suited to California. I have recently made arrangements to identify all the numerous Eucalyptus species now growing in California, an undertaking made all the easier by the remarkably early flowering of most of the genus. It certainly is a striking thing to observe these finally giant trees so often flowering when no more than a bush. The utility of

work of this kind is apparent when we consider the wide range of conditions in California. The blue gum, while so generally suited to California, has a hard time in some places and will not grow at all in others. In the boulders or sands of the torrent beds of Southern California the blue gum is often over-matched by the lightness or dryness of the soil or lack of soil. Again, in exposed places like the old alkali districts of such elevated plateaus as that which we used to call the Mojave desert, the blue gum is sometimes killed by the alkali and sometimes by low temperature. The thermometer in these places sometimes falls to 2° above zero, and in one or two places even zero has been recorded.

It is doubtful whether any valuable Eucalyptus will do well under such conditions, but it is certain that the blue gum will not. The species to try would be Eucalyptus rostrata, Eucalyptus viminalis, Eucalyptus urnigera, Eucalyptus robusta, Eucalyptus amygdalina and Eucalyptus Gunnii. No Eucalyptus has resisted the conditions at Lancaster on the Mojave. Numbers of fruit trees do well there and the Fremont poplar seems quite at home. At points nearer the Sierra Madre in this ex-Mojave section, now called Antelope Valley, various species of Eucalyptus have succeeded, but only locally, at or near Palmdale and the Rock Creek mesa. Mr. John J. Jones, of Palmdale, writes me that viminalis with him has stood more cold without leaf-burning by five degrees than Eucalyptus globulus or Eucalyptus rostrata. His minimum in a protected porch is 16° F. The West Australian Eucalyptus cornuta was killed outright, while the red and blue gums live but are very often frost burnt.

Reports from Kew gardens, England, recently sent to

me, state that Eucalyptus urnigera, Eucalyptus coccifera, Eucalyptus viminalis and Eucalyptus Gunnii are "by far the hardiest species in England, and have withstood temperatures as low as 10° above zero. In the Channel Islands Eucalyptus globulus and others grow freely."

The two first species have only recently been introduced into California.

When it comes to the dry sandy situations we have a better tree in the Eucalyptus haemastoma or Eucalyptus hemiphloia. And for dry places with strong soil Eucalyptus cornuta and especially Eucalyptus corynocalyx are more successful than the blue gum. For wet soils and sea coast exposure the best species is Eucalyptus robusta. The Eucalyptus which has stood the most frost in California is probably one at Chico. This tree is reported uninjured by two severe winters. One of my ex-forestry officers, Mr. W. S. Lyon, on the authority of Baron Von Mueller, calls it Eucalyptus amygdalina variety angustifolia. Amygdalina is said by Von Mueller to be one of the best frost resisters of the genus, but I can find no such variety credited to it as angustifolia. There is a variety named angustifolia, however, of Eucalyptus crebra, which is a very good tree. So we have some confusion about this frost resister until we can examine it botanically and learn to a certainty where it belongs. (I have recently seen a specimen of this tree. It is an amygdalina and a narrow leaf variety.)

Reports from the large number of experiments with species of Eucalyptus throughout California, from seeds or plants introduced and sent out by me, when Chairman of the State Board of Forestry, are generally unsatisfactory. Upon a resumé of these we may say that the sugar gum will stand more drought than the blue gum, but no more

frost; that the red gum (Eucalyptus rostrata) stands more frost than the blue gum; that the manna gum (Eucalyptus Viminalis) stands both frost and drought better than the blue gum. I feel a great regret that I cannot give definite figures on temperature resisted by the different species. Frosty places, at least in Southern California, hate to confess the whole truth, or, as they say, the exceptional facts about frost. From my own plantings some experiences will be occasionally given. These plantings were made at Santa Monica on the Pacific Ocean, and at Kinneloa ranch on the foot-hills of the Sierra Madre, in the San Gabriel Valley. The lowest temperature recorded at the ranch house, with a self-registering thermometer, has been 32°, and this but twice in 15 years. At Santa Monica, Mr. Hugh Casey generally has a tomato vine running to the roof of his house and fruiting all winter, so there also it is very mild.

The lowest temperature recorded at the Forestry station, Santa Monica, was 30° Fahrenheit. The extraordinary differences of degrees of frost within short distances, in California, makes it essential to look carefully into temperature records as evidences of what plants will stand in the way of cold. The examination is necessary, not in doubt about the record, but in discovering its applicability to the plantations under consideration. The thermometer at my ranch is on the inside of an outer pillar, on the south side of the piazza, about ten feet from the ground. On the terrace in front and close to the piazza grows a banana that has never been cut back, but the ends of the top leaves have been frost burned several times. Close below on a bank is a scarlet flowered passion vine; part of it grows to the top of a palm tree. On the bank, the vine leaves have

been frosted about every third year; but the vine in the palm, even close to the ground, has never been touched.

The thermometer may easily vary many degrees at the same time, on the same ranch, or in the same valley.

EUCALYPTUS GLOBULUS.

The blue gum being the most valued of the genus Eucalyptus, it will be appropriate to give some more intimate account of this wonderful hard wood Jack's-bean-stalk growing tree. I will commence with some account of my own acquaintance with it at Santa Monica, and at the ranch in the San Gabriel.

The town streets at Santa Monica were planted with Eucalyptus globulus, blue gum, about 1876, and the trees were not subsequently cared for. It has done remarkably well and made large trees. The lines are now broken on account of the town policy to allow lot owners to chop down the trees on the streets at their front. Many have been thus used for fire wood. The first line of blue gums on the bluff at the ocean front have been much deformed and stunted and sea burned by the trade wind, which steadily blows at this place through the whole summer. These gums were alternated with Monterey Cypress, which have been deformed also by the trade wind, but not so badly sea burned. Where there was summer moisture, as at a stand pipe for the street watering, the blue gums withstood the trade wind effects and have grown to be large trees. The second line of blue gums across the ocean front avenue have been practically unaffected by the

trade wind. Every three or four years, great numbers of blue gum seedlings have come up about the town. These have been taken up by the people and sold to the nurseries. The years of these seedlings have been ones of more than average rain fall. The blue gum is at home at Santa Monica.

At Kinneloa the blue gum does well in strong soil. On the very light sandy places without water or cultivation trees have died of drought. In the late summer of years following a season of light rains nearly all the trees in sandy wastes have lost foliage to a perceptible extent, but in spite of all this I have cut considerable fire wood from a sand wash plantation and the trees are now coming out again vigorously from the stumps. At Santa Monica there is a scale on the blue gums that I have seen only on the fruit. It seems to do no harm and looks to me like our willow scale. It may be appropriate to mention that in Australia there is a scale, a species of Lecanium, that infests both the red and manna gums. This scale causes a viscid sweet juice to exude from the tree and to drop on the leaves and branchlets, which is very attractive to ants. In this effect we are reminded of the black scale and its sweet secretion on our orange trees. It is probably very lucky that our Eucalyptus have been imported by seed thus avoiding the introduction of this scale. The impression prevalent in California that all Eucalypti are free from insect pests is not in accordance with the reports from Australia in regard to the Lecanium as well as in regard to certain cicadæ. Some of these latter do considerable injury by boring while others eat the tree leaves. Baron Von Mueller reports that these foliage eaters seem to be increasing in Australia. Quite frequently extensive districts

have the trees killed by the repeated destruction of the leaves in the same season thus giving the tree no opportunity to recuperate. The blue gum however has not been reported to have been destroyed by the cicadæ. Consul Baker reports from the Argentine that the Eucalyptus is the only tree introduced to the wide plains of that Republic not destroyed by locusts.

The borers attack Eucalyptus viminalis more than any other tree. From their punctures exudes a sweet, amorphous and whitish substance, much prized by the natives. From this mellitose substance the viminalis has obtained the name of manna gum. When this manna is found in comb-like pieces on the ground it is quite a pleasant sweet. We could doubtless obtain this manna by instrumental punctures. It is not the same as the true orcus-manna as Johnston's* Australian analysis shows, $C_{12} H_{14} O_{14}$, and the quantitative analysis of viminalis manna by Anderson is sugar 49.06, gum 5.77, starch 4.29, inulin 13.80, cellulose 12.04, water 15.01. This manna falls also from Eucalyptus oleosa and Eucalyptus odorata and occasionally from other Eucalypti but never to anything like the same extent as from Eucalyptus viminalis. I have only once seen manna on a gum tree in California. This was on Eucalyptus viminalis at Santa Monica Heights.

In mentioning these insect injuries to various species of Eucalyptus it is only proper to say that this genus has so far proved practically free from injurious insect effects wherever it has been introduced. Its introduction by seed alone has prevented the introduction of its Australian enemies and no exotic enemy of moment has thus far appeared. I may say, too, that in my own wanderings in

* From Von Mueller.

the Australian bush I have not observed insects injuring the Eucalyptus.

In South Australia Eucalyptus leucoxylon is called blue gum and in New South Wales Eucalyptus goniocalyx goes by the same name. Eucalyptus globulus is not indigenous to South Australia and is not a feature of the forests of New South Wales, except perhaps in a small far southern district adjacent to Victoria. Both of these species are hardy, fast growers, and valuable timber trees. In various districts the name blue gum is locally given also to Eucalyptus hæmastoma, Eucalyptus megacarpa, Eucalyptus rudis and to Eucalyptus saligna. Again, in other districts these trees have different popular names as may be seen by an accompanying index of Vernacular names taken from Von Mueller.

Eucalyptus globulus may always be distinguished by its glandular appearing fruits. These are of an unhealthy, bluish-white color until the seeds are fertilized. The coloring suggests a case of erysipelas painted with nitrate of silver. There is only one other species of Eucalyptus that has this rough, glandular seed box. This is Eucalyptus Alpina, a bush restricted in its native habitat to a few acres on Mt. William, in the Grampian Range, Victoria. Eucalyptus Alpina is the closest botanic ally of Eucalyptus globulus and still while the blue gum is the fastest grower of the genus, the Alpina is the slowest ; while one is a giant tree, the other is a dwarf bush ; while one is introduced into every section where the climate permits, the other is but a curiosity. A Eucalyptus Alpina planted in the botanic garden, at Melbourne, grew twelve feet in twenty-five years and had no central stem. When we consider the systemic affinity of these two species and

their divergent qualities we may well recall the little nursery rhyme about the star:

> "Thou art so near
> And yet so far."

This Mt. William seems to be a sort of botanic island, for upon it are found a considerable number of plants found nowhere else.

An experiment made with the blue gum by the Southern Pacific Railroad Company, showed it to be above the average for a tie in all respects but one. It checked to such an extent that room could hardly be found to bolt down the rails.

Wood cut at a different season, or better cured, might show very different results.

At the Chicago World's Fair specimens of blue gum wood from Australia worked for wagon wheels, in boards, and exhibited as a hard wood of general utility, suggests that the use of this wood in Australia, even for ship building, and its comparative neglect here, except for fire wood, is due to a difference in blue gum wood in the two countries, arising from situation, soil, climate, or the age of the tree.

More care and more experiments may demonstrate that we have, or will obtain as good blue gum wood here as there.

The blue gum is a sort of average Eucalyptus, tall but not the tallest; used for general purposes, even to piling and ship building; it is not the best of timber for any of these purposes; not the most lasting in the air, ground, or water; not the highest yield of oil; not the best honey-making tree for bees. It is still well up in all these respects. Like nearly all Eucalypti the tree should be

cut when the sap is least active, and should be worked into its final form of fire wood, boards, etc., as soon as possible after it is felled. I have seen blue gum logs become so hard that the cost, from increased difficulty of handling, ate up more than the final value. In cutting blue gums for piles, it is probable that the reverse course will be best—that is, when the sap is active. The wharfinger of the Port of San Francisco assures me that a pile cut when the sap is flowing—say in the spring—will last three to five times longer than when cut dormant.

The best success with the blue gum in California has been in situations where moisture is not far from the surface and where the ocean influence has affected the air, such as in the great Eucalyptus groves south of Los Angeles City. In many places this tree does well singly and in single lines, and it will furnish a continuous supply of fire wood, as on the borders of fields and orchards that are cultivated, when it will amount to little or nothing in a solid plantation. Thus, a new comer to some of our interior mesas will see with his own eyes, splendid specimens of blue gums in gardens, near a ditch or reservoir, or he may observe, by the side of cultivated fields, long rows of strong looking trees. Acting upon this, he may plant a forest of blue gums and get only a spindling, stunted growth, better than nothing, but that is about all one can say. Eucalyptus globulus will amount to little in groves where the soil is light or the subsoil dry. A continuous supply of fire wood can be obtained from blue gum by pollarding or cutting the tree back every three or four years. This Eucalyptus stands such treatment especially well. Some of the other species do not take kindly to this cutting back, but I believe none of them make the

complete revolt against it of the pine. To insure a new growth the pollarding should be done when the sap is running actively. Our redwood is, I believe, the only coniferous tree with this sprouting quality. Alone amongst its compeers, in this quality, the redwood exceeds in its persistent vitality for sending out suckers and shoots when cut down, all known trees.

The sprouting of the blue gum when cut adds to its value as a fuel tree, for in plantations it makes its first crop in about seven years and then for an indefinite period renews the crop every three to five years.

The blue gum to give best results for either timber or fuel should be planted 6 x 8 or 8 x 8, or certainly not more than 10 feet apart. The most successful pine plantation in California is at Monterey and of the Monterey pine. These trees are now eleven years old average 35 feet in height, are straight and clean in the stem and are planted 10 feet apart. This is the proper form for all forest tree plantations with but slight variation. The object of close planting is to obtain the maximum of a clear straight stem. This gives the best return with the most economical condition for gathering the crop, and is alike advantageous whether the crop is lumber, fire-wood, gum or bark. If the trees crowd each other as they grow they can be thinned out.

In European forestry it has generally been found best to mix plantations of forest trees. That is, plantations of one kind of tree solid are not found to succeed well. We have not had this experience in California. The Eucalyptus has certainly been tried enough to say that the great advantage and economy of solid plantation to one kind of tree is not neutralized by indifferent growing in this genus.

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In passing to other species we may leave the Eucalyptus globulus with this statement:

It accommodates itself to more conditions in a satisfactory way than any other Eucalyptus. Yet there is no one condition for which some other species of this genus is not better adapted. So also there is no use to which the blue gum is put for which another species is not more serviceable.

The blue gum is a jack-of-all-trades tree.

A fine specimen of a single Eucalyptus globulus is to be seen on the Banning estate at Wilmington, Los Angeles County, California. There is in another form a fine single tree at Mr. Rosenbaum's garden, Pasadena, and still another type in the L. J. Rose Company's garden, San Gabriel. A fine old roadside effect of these trees may be seen near the East San Gabriel Hotel. The growth and appearance of the blue gum in groves is well illustrated at and about Nadeau Station, south of the city limits of Los Angeles.

EUCALYPTUS MARGINATA.

My experiments at Santa Monica together with those at the old forestry station show that all the important species do well at that point except the jarrah, Eucalyptus marginata. This valuable tree is not only slow in growth but appears to have a tendency to foliage disease. Part of the trouble is probably caused by a fungus. The outer edge of the leaves commence to die during the winter or rainy season. Eucalyptus obliqua is also slow and unsatisfactory at Santa Monica. This is the par excellence stringy bark of Tasmania and Victoria. This tree does well, however,

in the middle interior. We lose little in losing the obliqua as a tree to recommend compared to the jarrah. This latter tree is reported to be teredo proof. It has been extensively used for piling and also for railroad ties in parts of India subject to the white ant. The reputation of the jarrah rests as to teredo resistance on the early constructed Australian wharves. It may be that the teredo was not native to Australian waters. The natural absence of the teredo, at least from the open coasts of California, has been asserted and the frequent wharves built out into the placid waters of the Southern coast are said to have at first enjoyed an immunity from teredo attacks. We have a very injurious pile enemy, even worse than the teredo that works only at the tide limits of the piles. This is the limnoria.

The early Australian experiences may have been due to an absence of teredo. A careful inquiry shows that several other species are very distasteful to insects. The most resistant of these are the Eucalyptus rostrata—red gum, Eucalyptus robusta—swamp mahogany, Eucalyptus diversicolor—karri.

This advantageous characteristic seems to depend on the wood of these trees containing a large proportion of kino-red. Frequent experiment in Australia has shown a marked difference in the amount of kino-red in the same species of Eucalyptus. The jarrah growing in light soil and generally in the open lowlands is very deficient in kino-red as compared to the trees growing on the strong iron soil of its native mountains. The jarrah, red gum and karri each contain a maximum of from 16 to 17 per cent. of this substance while the robusta contains 19 per cent., and exceeds all Australian trees in kino-red.

Some jarrah piles were brought to San Francisco a long time ago and tried by the harbor commissioners. These were destroyed by the teredo and other pile eaters in eighteen months. I saw the specimens when taken up and they were entirely riddled and were worthless. The question then arose as to whether the piling imported from Australia really was jarrah. To satisfy their doubt another lot of jarrah was ordered with such precautions as to insure the importation of the real thing. Unfortunately the record of this experiment was not made, or if made has been lost. I learn from the present engineer of the Board that there is mention of Karri piles but that these were taken out some time ago without examination to make way for the sea wall. So while several kinds of Eucalyptus piling reputed resistant to toredo, etc., have been tried in San Francisco, no reliable record appears to exist of them.

The San Francisco Harbor Commission is by no means up to the average as an example of the extravagance and inefficiency in our public service.

Our machine system of politics develops the faculties of trades, combines, direct or indirect briberies and political fence walking in public men. The lower qualities are developed, the higher ones dwarfed by non-user—certainly never developed.

Our public service is now manned by those who have rendered partisan service, by their friends or by persons with a pull, as by those going on official bonds, or by those paying the police blackmail on dives and prostitution or by large corporate interests using direct and indirect influence both in elective and appointive officers.

Merit and capacity are wholly secondary as a means of

notice in the public employ. In fact indifference and incapacity is a recommendation to machine boss methods for political employment. Even rank scandals involving corrupt catering to corporate interest by public officers often fails to neutralize the strength of our political machine and the outcry of public indignation is deadened by the din of the partisan tom-tom.

How long the supposedly intelligent American people will continue to be played by the partisan pannel game is impossible to foretell.

I have a particular prejudice against our partisan follies because they continually confront me in all public interests. Even good and able men in public office secure and maintain their places by their lower and not by their higher faculties. The political machine generally dominates the public business, but its indifference to public interests, its incapacities and degradations are distinctly countered by the currents of public opinion. The growing altruism of humanity is against the use of faction, sordid private interest or the ministering of personal pride to organize bands of partisans to exploit public office and public taxes for private plunder.

Well, well! Let us look on the bright side for the future and trust that the strong young seedlings of popular demand for capacity, honesty and responsibility in the public service will grow like blue gum saplings and like them clear the political malaria away that makes us all sick.

In repeating experiments, such as those in San Francisco harbor, it may be noted that the teredo thrives best in clear sea water and dies in clear sewage. The resistance of piling to teredo may therefore be very different

though of the same kind of wood when differently exposed in a harbor. The jarrah has grown in several sheltered places in California as at the Cahuenga, but so slowly and it so often fails to grow at all, that there is little encouragement to plant it.

While a large number of instances of teredo resistance in the Eucalyptus marginata are reported, carefully conducted experiments like that in Auckland Harbor, do not substantiate them.

We will know more about this teredo pest after awhile. The introduction of some natural enemy of the teredo has been suggested and a great variety of experiments are being tried, amongst them is one at San Pedro, where the piles are protected by vitrified sewer pipe.

I have a report of a Jarrah, 65 feet high, 25 years old, at Santa Clara. The identification of the species has not been verified, however.

The best specimens of Eucalyptus marginata are at the Cahuenga, Los Angeles County. The general type of poor growth in California, can be seen at the Forestry Station, Santa Monica, and at the Paradise Nurseries, South Pasadena.

It may be well to mention here that the common blue gum produces, about Santa Barbara, a pile that resists both the teredo and limnaria better than the Oregon spruce sticks, better even than these creosoted. In consequence, the wharf at that point is now maintained by blue gum piling.

EUCALYPTUS ROBUSTA.

For convenience we may consent to the name Eucalyptus robusta for the fine tree thus known in California. It is, however, either a variety or another species, probably Eucalyptus Kirtoniana. The variation in our so-called Eucalyptus robusta from the true type, seems to be only in the flower cap. In the typical Eucalyptus robusta this cap is much broader than the calyx tube, bulging out something like the cap of Eucalyptus gomphocephala, while in the tree we have as Eucalyptus robusta the cap is long and not broader than the calyx tube.

Eucalyptus robusta is a good fast grower, and among the handsomest of the genus. It has large, dark green leaves, and, like so many of the Eucalypti, flowers early and profusely. The flowers are cream colored. We know that Eucalyptus robusta has done well on the bluff at Santa Monica, in Los Angeles, and in the San Gabriel Valley. The tree is a swamp tree, and naturally takes to low wet ground, and thrives even in sour and alkali land. I was surprised to find it doing so exceptionally well in upland situations. Eucalyptus robusta has not been tried very long here, and it may not continue to grow fast after a few years. Many Australian trees, especially in the acacias, grow wonderfully for four or five years and then become scrawny and miserable. The Grevillia, with its feathery foliage and deep yellow flowers, is one of these beautiful disappointments. Eucalyptus robusta is very promising, but in the numerous forest plantations of South Australia, the largest and most complete forest stations dealing with Eucalypti in the world, it seems but little noticed.

This colony has 29 forest stations and several small ex-

perimental grounds. These were for a long time under the charge of Mr. J. Ednie Brown, a distinguished forester, afterward Director General of Forests to the Colony of New South Wales. It was under his excellent management that the value of many of the Eucalyptus species was demonstrated. Amongst these we may mention specially Eucalyptus viminalis, Eucalyptus leucoxylon, and Eucalyptus corynocalyx, for dry and arid locations, and of the first two as frost resisters. After long and careful trial, the Eucalyptus corynocalyx was shown to be the best Eucalyptus for the very dry and trying stations in the north and hotter parts of South Australia.

There are a few Eucalyptus robustas in plantations about Los Angeles, and quite a number alone or in rows. When alone, it grows in an excellent shape for a road tree, with a well formed head, round and not too tall, making a good shade for the sidewalk, without shutting off sunshine from adjacent houses.

The timber of this tree is a dark, handsome red, due to the very large amount of kino it contains.

Specimens of Eucalyptus robusta as a single tree can be seen at the Forestry Station, Santa Monica, and as a roadside tree on Downey Avenue, near Mr. Hancock Johnson's place. The form of growth of this tree in a grove can be seen at Dr. Wernigk's place, Alhambra, Cal. There is a very pretty effect from a plantation of these trees at the railroad entrance to the county farm near Los Angeles. My experiments on very alkaline ground show that Eucalyptus rostrata is more resistant than robusta.

EUCALYPTUS CORYNOCALYX.

Eucalyptus corynocalyx is the sugar gum. This popular name is due to the character of the foliage which, while sweetish, contains comparatively little oil, and is, therefore, acceptable to stock. In chewing the leaves of the sugar gum, the first taste is agreeable, but immediately a bitter resinous flavor succeeds. It leaves a persistent after taste of almonds. There is no suggestion of sweetness to me. Australian reports say that it is the only Eucalyptus, unless perhaps Eucalyptus Gunnii, that stock and sheep will eat. This is not an especially desirable quality in a tree, but in any case it is not true of California that the sugar gum has this monopoly.

While a road master in the Santa Monica district, I undertook the planting of trees by the roadsides. Too often roads ran for considerable distances through open, unsettled plains, used by stock and traversed by sheep.

I planted Eucalyptus trees, for the small fund available permitted only the use of trees that could be transplanted to roadside, conditions small, and therefore at low cost, and that would soon need no care at all. The cattle would break down the young Eucalyptus trees, but did not seem to eat them ; the sheep, however, crossing in the fall, with scant feed, would eat off every leaf from the young trees in their path, and from trees of several species including the blue gum. The ground squirrels, then plentiful, had the curious habit of biting off the young trees at the root crown and leaving them dead. Rabbits do the same thing, and will do it over and over again on re-

plants, for reasons that I cannot guess at, unless it be an antipathy to forests from hereditary experience of unfavorable conditions for rabbits and ground squirrels. It may be interesting to some prospective planter to know how the squirrels were conquered. I poisoned them with strychnine in watermelons for six miles in a strip sixteen hundred feet wide, then had boys cover the holes. All the holes reopened within ten days were reclosed, after placing a piece of cotton saturated with bi-sulphide of carbon inside. The first method is a cheap, wholesale scheme, but will not kill on a second trial those few that escape the first. The squirrels will not again take it. The second is too expensive for wholesale work, but is excellent as a sort of amen. The trees on these six miles of road are now safe, and make a most pleasing difference in the appearance and comfort of the roads. In this road planting I used a number of varieties. In fact, most of the trees were donated and we took what we could get, otherwise the business and frequent re-plants could not, from financial reasons, have been brought to a successful finish. I hope that I so grouped the trees and arranged the lines that the present pleasing effect will not be lost. In general, good effects in road side tree planting are best obtained by a single species of tree. When a street or road has trees planted on it without either a unity of species or a unity of plan it is incapable of an inspiring effect. The old elm lined streets in New England are both beautiful and glorious. Once seen they cannot be forgotten. The striking beauty of these roads is due to the monopoly of the elm. But a medley of trees on a street is a confused bungle incapable of greatness. In our remarkable Southern California progress we see a good many cases of this

error. The development being due to individual initiative instead, as in Europe, to government authority, we find a progress rapid and sound but with minor defects, such as streets and roads connecting with nothing and often platted into a confusion of no-thoroughfare and mixed direction as in Los Angeles. The tree-planting on streets is one of our systemic defects. Real estate men putting tracts on the market will often plant trees on their new streets. As a rule they select cheap ones that require little care. Blue gum and pepper are from this view the most popular. Then comes the lot owner. Nearly always one or more will be found on a stretch of road who do not like the tree planted, no matter what it is. Occasionally the kicker rebels against any tree and wants sunshine instead. Thus we often find tract-streets and roadways with well grown trees of Eucalyptus or pepper but with the lines broken and the effects destroyed by lot-owners here and there who chop out the established tree and replace it with something of their own fancy. We may all hope that after awhile it will be recognized that an avenue with one kind of tree well established may be a thing of beauty and renown and, to be practical, a thing of money value to the lot owner; while such a line, broken here for a few grevillias, at another point for palms, etc., loses all individual identity as a grand avenue. Such a massacre leaves the avenue perhaps better than if quite divested of trees, but the confusion and barbarism of such treatment is so painful to one capable of artistic feeling that an entirely fresh start on an harmonious plan would be preferable to any such inconsequent muddling. Dr. Charles P. Murray, a road master in the Sierra Madre district, was one of the few road officers

here in the South who appreciated this fact and acted up to it. His planting of sugar gums on the Lamanda and Sierra Madre road is a growing monument to his memory. But even this active and public spirited man was unable to secure unity along this entire line.

These roadside gums bring us back to our muttons, or rather to the tree they eat. Part of this sugar gum road is in a sandy wash and part on a firm, strong soil. The trees are five years old but on the two soils appear to be of very different ages. Those on the sand, while attractive are inferior in size, density of foliage and general vigor to those on the red soil, and they do not look as old. I do not know anything that more often recalls in tender memories a friend and noble citizen than these trees which he took such care to start strongly and in which he took such pleasure.

Walter Gill, Forest Conservator of South Australia, writes me of the great difference in the value of sugar gums as timber producers, due to the soil, exposure and climate to which they are subjected. On heavy and strong soil this tree, he finds, makes a valuable timber, while on sand locations it is not a good timber maker. The bole is unusually straight, stocky and clear.

All timber trees are affected in their products in the same way. Cordier (Algiers) does not think sugar gum a good forest tree—but finds it ornamental.

The sugar gum naturally makes a more symmetrical top than most of the Eucalypti. This is favorable in a road tree, and then, its dark green glossy foliage and striking white stem with red branches, make it very attractive. Another good point is its resistance to heat and drought.

To Mr. J. Ednie Brown is due the credit of discover-

ing the merits of this tree for hot and dry places. In his report of 1881-2, he says, page 12:

"Undoubtedly the sugar gum is the best of all our Eucalyptus for planting in a district where the rainfall is somewhat uncertain. Some 12,000 trees of this species were planted here (Bundaleer Reserve.) Of these there are 9,000 which have survived the dry season and have made excellent progress. During the dryest and most trying period of the year they continued to grow and looked well at all times. From my experience of this gum I cannot too highly recommend its general use for planting in the drier portion of the colony." (South Australia).

Again, in his report of 1883-4, page 25, he says of an interior dry reserve that the following trees did poorly and were unsuited to the dry interior: Eucalyptus longifolia, Eucalyptus amygdalina, Eucalyptus resinefera, Eucalyptus marginata, Eucalyptus siderópholia. "The Eucalyptus globulus, also all died off during the summer. This tree requires more moisture than is precipitated on the reserve under review (Mt. Brown) and the planting of it will consequently be discontinued here in future."

"Those kinds of trees which have given satisfaction in the plantation of this reserve are Eucalyptus corynocalyx (sugar gum), Eucalyptus leucoxylon (South Australian blue gum) Eucalyptus viminalis (manna gum), Eucalyptus cornuta (yate gum), and E. gomphocephala (tooart gum)."

Coming down to '92 we find in that year's report from South Australia an inventory of the colony's nursery stock available for planting which shows the favor in which the leading trees stood from the experiences of the 29 Reserves and numerous planting grounds. Here are the principal trees:

Eucalyptus corynocalyx, sugar gum	281,958
" globulus, blue gum	4,710
" leucoxylon, S. A. blue gum	6,498
" rostrata, S. A. red gum	1,741
" viminalis, manna gum	18,149
" cornuta, yate gum	17,481
" calophylla, W. A. red gum	1,499
" gomphocephala, tooart gum	935
" marginata, jarrah	2,000
Pinus insignis, Monterey pine	60,174
" maritima, cluster pine	36,814
" halepensis, Aleppo pine	21,604
" pinea, stone pine	1,695
Cupressus sempervirens	2,298
Ulmus suberosa, cork elm	1,700
Quercus robur, English oak	15,712
" pedunculata, English oak	3,000
Acer pseudo-platanus, sycamore	1,880
Melia azederach, white cedar	4,019
Schinus molle, pepper tree	6,645
Tamarix gallica	5,864
Juglans regia, walnut	8,270
Salix Babylonica, weeping willow	2,566
Olea Europea, olive	5,655
Populus fastigata, poplar	4,742

This nursery stock was planted under the direction of Mr. Walter Gill, Mr. Brown's successor, thus eliminating the personal equation.

Eucalyptus leucoxylon in the above list, is the white, smooth barked or typical tree of that species. It is generally spoken of as the South Australia blue gum, while Eucalyptus sideroxylon is called an ironbark.

The same proportion is presumable in the popularity of the trees, as is shown in this list. Such a list would not correspond with California tree popularity. It demonstrates however the high esteem in which the sugar gum has come to be held in South Australia. The South Australian reports show continued popularity of the sugar gum over all other trees.

Another South Australian report gives the principal trees planted in that colony during the year to have been:

Eucalyptus corynocalyx	422,687
" globulus	48,360
" leucoxylon (S. A. blue gum)	14,453
" rostrata	44,040
Pinus insignis	87,230
" pinaster	42,060
Quercus robur	59,000

The young sugar gum has nearly round leaves of the same dark color as the mature form and generally has a steel blue glint in or over the dark green. This young form is much more persistent in the sugar than in the blue gum, in fact, trees at least six years old still have the lower third of their foliage more or less oval. The mature form is lanceolate in shape. The new growth is a lively reddish color similar to the new wood of an apricot orchard seen from a distance just before the bloom. In the growing season the tops and often one side of the trees have a red appearance which on the dark green foliage is pleasing. The botanical name of this tree (corynocalyx) refers to the club shape of the calyx before flowering; a shape peculiar to this tree alone amongst the Eucalyptus (Von Mueller.) The fruit is shaped similar to an Indian club and according to Von Mueller is striped or grooved. The sugar

gum fruits on my ranch have not the latter characteristic. The genus has one other tree similar in its fruits to the corynocalyx, this is Eucalyptus urnigera, a species confined to the alpine districts of Tasmania, there reaching a height of fifty feet. The descriptions of this tree that I have found are so meagre that I am unable to say whether the similarity renders the distinction of these difficult or not. As it is, the sugar and the blue gums are the two Eucalypti which in Southern California are now deemed most surely and easily recognizable. The style in the sugar gum is exactly like an Indian club in shape. The tree reaches a height of 120 feet, makes a thick stem and is exceedingly durable as posts, ties, etc. In this connection it may be noted that many of the most durable of Eucalyptus woods contain large amounts of kino-red. Sugar gum timber is about the least likely to warp of that of any of the gums, a point of high recommendation. It also resists white ants and insects generally and is more and more recognized as one of the most valuable of South Australian timbers running close to Eucalyptus rostrata in popularity. The sugar gum has been extensively planted in Southern California but in a scattering, ornamental way only. No bodies of this timber in commercial quantities exist. In fact I may as well say here that the blue gum is the only forest tree of any kind planted here with a commercial end in view. The sugar gum resists frost better than the cornuta. At my ranch cornutas in the same plantation with the sugar gums were lightly frost burned in our recent severe weather, '93, while the same sized sugar gums were untouched. The young sugar gums, however, were lightly frosted. (These trees however were located in an extra cold low torrent bed).

The sugar gum does well at the sea side when not

directly exposed to the strong sea breeze. It cannot stand the conditions of the trade wind immediately on the bluff at Santa Monica without protection. A line of these trees planted on the bluff side of the Arcadia garden by Mr. J. W. Scott were badly sea burned and would have died had not this gentleman erected a high picket fence on the windward side of them. These have remained vigorous but cannot grow far above the fence because the sea breeze kills them back above that point. I first saw this open style of windbrake at Woodward's Garden, a zoölogical garden and place of resort in San Francisco. It was in the shape of an enormously high lath fence and had replaced one of solid boarding which had failed in its purpose. It is this fact which doubtless makes a tree windbreak so effective, and an open growing tree like Eucalyptus better than a close growing one like the Monterey cypress. I have seen orange trees that had been blown over immediately under the lee of a dense cypress hedge over 50 feet high while the orange trees immediately to windward were unmoved. In this case there was protection from the windbrake but in its front instead of in its rear. Seventh street, a great thoroughfare in Los Angeles, has been planted at its west end by the property owners with sugar gums. From this extensive experiment we will soon be able to judge how the sugar gum will succeed on a city street with sidewalks, etc.

Eucalyptus corynocalyx does well all over this county. One of the best single specimens is in my garden at Santa Monica. Many more can be seen at Santa Monica Heights. One of the oldest roadside plantings of the sugar gum is on the Lamanda Park road in Sierra Madre, Cal. This road shows well what can be expected of Eucalyptus corynocalyx on both sand and good soil in our interior valleys.

EUCALPTUS ROBUSTA.

Previously allusion has been made to the fact that Eucalyptus robusta, as we have it, varies in the cap part of the calyx from the typical tree of this name, in that the cap is the same size, or a little narrower, than the calyx tube while, in Von Mueller's plate the cap lid, or operculum, is much broader.

Eucalyptus robusta is one of several trees known in Australia as mahogany, a vernacular name which excites the opposition of Von Mueller.

The reddish coloring of the wood has doubtless dubbed these trees mahogany. There is however nothing else to warrant the name. Several other species of Eucalyptus containing considerable kino are also called mahogany.

Eucalyptus Kirtoniana, a variety of robusta, perhaps the one we have, is according to experiments in India (Oude) reported by Von Mueller well suited to tropical conditions. Under these conditions this tree has grown 45 feet in ten years (Lucknow). Eucalyptus robusta is reported as specially tolerant of wet, sour or alkali lands. An experiment of Mr. Ryan and myself at the Ballona will soon test their value in this regard with us.

The indications of the experiment are that Eucalyptus rostrata is a better tree for alkali. Eucalyptus robusta has now a great popularity as a road tree. Its head is compact and symmetrical, its leaves dark green, its flowers profuse and creamy white. The bark is rough and persistent. The oldest Eucalyptus robusta on a street that I know are on Downey avenue, East Los Angeles, near Mr. Hancock Johnson's place. Fine specimens may be seen at Santa Monica, one of them is at the Forestry

Station. The timber is of a beautiful red color and is used in building, etc. It also makes a good fuel. I have reports that indicate brittleness of mature trees in strong winds.

This variety resembles somewhat Eucalyptus resinifera.

EUCALYPTUS RESINIFERA.

Eucalyptus resinifera, is a valuable tree with a large percentage of kino in the wood. It does well in Southern California. While probably of equal utility with Eucalyptus robusta it is not so handsome a tree. Eucalyptus robusta under favorable conditions near the sea coast and in moist land is likely to prove the handsomest foliaged tree of the genus we have introduced. A fine specimen of the resinifera can be seen at the Forestry Station. There are a number of old specimens, '76, in the Nevada Ave., park, Santa Monica.

The kino of commerce is largely derived from districts about Sydney, and has been attributed to Eucalyptus resinifera. In fact it is named after this tree. It now appears that this kino is mainly derived from Eucalyptus siderophloia and that little if any is from Eucalyptus resinifera.

The Eucalypti containing a large percentage of kino in the wood have usually a small amount of oil in the foliage.

It is therefore to be presumed that the best sanitary effects can not be obtained from such species.

EUCALYPTUS ROSTRATA.

Eucalyptus rostrata, red gum, has both a large percentage of kino in the wood and a fair percentage of oil in the foliage, not indeed enough oil for the best commercial results, but probably enough to give encouragement for its production for special sanitary effects. The valeraldehyde with the oil in Eucalyptus rostrata leaves is claimed to have a peculiar medicinal value. The Australian natives are reported as preferring the leaves of the rostrata for medicinal purposes to those of other Eucalypti.

Eucalyptus rostrata is a stocky tree about 100 feet tall when mature, though occasionally observed to be 250 feet. It contains a considerable amount of timber for its height. The tree is widely distributed throughout the interior of Australia, along flood courses and on wet lands.

Just as its desert habitat would indicate, we find it resistant to extremes of heat and to more cold than the coast species of Eucalyptus can stand. Our experiments show Eucalyptus rostrata to be the all round hardiest species of Eucalyptus introduced into California. I am confident that it will succeed in Arizona, where so many Eucalypti have failed. One of our surprises was the drought resisting power of this species. It is one of the best in this respect.

It prefers and does best in heavy to wet lands, but grows well also on our dry plains in strong soil with 10 to 15 inches of rain. While not naturally often found near the Australian coasts, my experiments at Santa Monica demonstrate that a little back from the bluff it thrives with vigor on our coast.

In its first years it is not attractive, but after three or four years the foliage seems to become brighter and greener, and, when the new shoots are coming on, it is the finest green of any of the Eucalypti we have.

The timber of this tree is highly valued, especially for its durability in ground and water. This quality is attributed to the large percentage of kino-tannin and kino-red the wood contains. The other species sharing with it in reputation of durability generally contain large amounts of kino. Some of these are Eucalyptus resinifera, Eucalyptus robusta Eucalyptus marginata, Eucalyptus diversicolor, Eucalyptus siderophloia.

Eucalyptus rostrata has suffered in California through its mistaken identification with various other Eucalypti.

I know of no specimens of Eucalyptus rostrata, except those about Santa Barbara in California, that antedate the ones grown from seed imported by me while Chairman of the State Board of Forestry. All trees reported as red gums and visited and examined by botanists have turned out to be other species—generally viminalis. There may be old, individual rostratas in the State, but certainly no plantations of rostrata (red gum,) as such, other than Cooper's were made before the Forestry Board distributions.

This is regretable on account of the hardiness and value of the true rostrata.

The vernacular name of red gum is not confined in Australia to the rostrata. This is one fact to which we may attribute the early mistakes in attempts to plant Eucalyptus rostrata.

In the San Gabriel Valley Eucalyptus rostrata is one of our hardiest trees and a fast grower. One of the earlier planted rostratas is at the place of Dr. Wernigk, in the

Alhambra. It was sent to him from a Los Angeles nursery as Eucalyptus maculata. The growth of this tree has been so satisfactory that many seeds have been taken from it by local nurserymen and the resulting trees sold as "maculata."

I have a very fine specimen of Eucalyptus rostrata in a foot hill gorge on my ranch that has thriven splendidly amongst the native growth. Eucalypti, as a rule, do not thrive in California on uncleared lands in competition with the local scrub or trees. Algerian reports indicate the same fact to have been noted there.

Outlying districts, as on the borders of the Mojave desert, where the conditions are scarcely semi-tropic, have proved the great hardiness of Eucalyptus rostrata. The value of its timber and its resistant qualities to heat and frost should insure to it a greater attention, especially in interior districts. Besides these advantages, it comes well from the seed and is hardy from the start, not suffering from damp-off, etc.

Experiments being now made with Eucalyptus trees by Mr. Salter, near Phoenix, Arizona, show that the two best thus far are Eucalyptus rostrata and a variety of Eucalyptus occidentalis, sent out as the yellow flowering gum. There are plenty of Eucalyptus rostratas about Santa Monica, especially on Nevada avenue and on the Heights. At Hon. Ellwood Cooper's estate, near Santa Barbara, there are some fine old groves of Eucalyptus rostrata. At that place it has proved to be one of the few self seeders. In the rich little valley at Ellwood numbers of rostratas have started from the seed naturally and grown into little groves. The habit of this tree is not so erect as that of Eucalyptus globulus. Consequently it does not make as

good a piling as the blue gum, though more resistant and durable than that tree. The odor of the leaves of Eucalyptus rostrata is very agreeable to me. Its characteristic smell is found also in the foliage of Eucalyptus tereticornis, and, as far as I have observed, only in these two.

Leuhmann speaks of a dark red and a pale red variety of Eucalyptus rostrata. The pale red variety has the strongest timber. We do not know how to distinguish these varieties, and do not know which one we have.

Experiments at the Santa Barbara wharf will bye and bye test the value of Eucalyptus rostrata and a number of other Eucalypti for piling.

EUCALYPTUS VIMINALIS.

Eucalyptus viminalis is here always a very different looking tree from Eucalyptus rostrata. As we have it the viminalis grows tall and is at first very slim, with drooping branchlets. Its young growth is reddish, or red brown, as compared with the bright assertive green of the rostrata. The bark is either darker and a little rougher or much whiter and smoother than that of Eucalyptus rostrata. The Eucalyptus rostrata bark is persistent, even and of ashy color, or reddish to old rose. The one tree is stocky, while the other is slim and willowy.

There are two varieties of Eucalyptus viminalis. One of them has a smooth bark from decortication, much smoother than that of the red gum, which does not decorticate; while the other variety is rougher, with generally persistent bark. Most of the viminalis trees here are smooth barks. The best specimens of the rough barked variety

are on the Berkeley campus. At this place there is also a fine smooth barked specimen.

Eucalyptus viminalis is a fast grower, hardier to frost and drought than the blue gum, but fails as to drought in light soils, where the sugar gum does well. Its foliage contains 16 per cent of fruit sugar to 10.42 per cent in that of rostrata.

The viminalis has stood the exceptional semi-tropic frosts of some of our interior California valleys very well. When established it will resist 10° F., and perhaps a lower temperature. In the Victorian gorges it has been noted as attaining a height of 320 feet. In the open, however, it rarely exceeds 120 feet.

The timber of this tree varies in value, none being really good. That from trees in the moist gorges is best, while that from trees in the open is generally inferior and brittle.

This tree, in the light sandy soils of the San Gabriel Valley old torrent beds, is slow in growth, scant in foliage, and in very dry years has a death rate little less than similarly placed blue gums. The sugar gum is the best tree for these places.

The wood of Eucalyptus viminalis is remarkably fissile, but is not durable in the ground. It is too irregular and drooping in its first years of growth for a good street tree. There are a number planted on one road on the Santa Anita ranch. Some I planted very close together at the bridge approaches on Nevada avenue produce a pleasing effect. Splendid giant single specimens exist at Ellwood, near Santa Barbara, and one stands in the center of a minor street parallel to and between Fair Oaks and Orange Grove avenues, Pasadena.

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EUCALYPTUS STUARTIANA.

Eucalyptus Stuartiana is another Eucalyptus that has been planted here for rostrata. It is allied to both the viminalis and the rostrata, but is easily recognizable from either, both in the seedling form and when mature. As a seedling it has opposite gamophylous round leaves of a blue color, branchlets willowy. Eucalyptus viminalis seedling has a willowy growth, suggesting that of a running vine, its opposite leaves are long, pointed, and of a saturated green. Eucalyptus rostrata seedling is stiff, upright and totally different. The mature Stuartiana is stocky, bark rough, foliage grey, and young growth of a steel bluish glint. It is a good hardy tree here and does well. The best specimens I know of this tree are those planted by me on the National Boulevard, near the Santa Monica reservoir, and those at the Paradise Nursery, Pasadena. The outside lines of trees on the National Boulevard are nearly all blue gums, while the two inner lines are of different species of Eucalyptus. There is a sufficient uniformity to give dignity to the effect, while the various species give a pleasing variety.

In Australia the general effect of the Eucalyptus "bush" and forests is monotonous and depressing. Ashey hues predominate and the growth is often scattered and scrawny. I recollect one tract in the Blue Mountains of N. S. W. where a Eucalyptus that shed its bark in long bands predominated. The foliage was scant and the trees contorted. It was a scene that might have been created by Doré. There was something weirdly human about it, as though an army of ill fed beggars had taken root in the soil with

tattered covering still hanging about them. Yet it is from this genus that more exotic forest tree plantations have been made than from all other trees combined.

Although suited to tropical, or semi-tropical and mild climates only, the Eucalyptus is more widely known in *persona propria* than any other exotic tree.

The timber of Eucalyptus Stuartiana has a varying reputation. It is a very hard wood, does not burn well, nor split well. As fence posts it is not deemed as good as Eucalyptus rostrata.

EUCALYPTUS AMYGDALINA.

Eucalyptus amygdalina is the tallest of the Australian trees, and the tallest tree in the world, yet the amygdalinas in Southern California have, in no case, equaled in size local blue gums. Their manner of growth here gives little prospect that they will ever surpass Eucalyptus globulus. The handsomest specimen in the South is at the place of Mrs. Jennie C. Carr, Pasadena. Another fine specimen is at Santa Barbara, in Mr. Cooper's place. We have several varieties of amygdalina in Southern California. Three of these are very distinct, and there are two others that are probably worthy of being ranked as varieties:

1st. There is the typical amygdalina, which is, I believe, called Eucalyptus amygdalina, variety regnans. It is the variety which has attained the giant stature of the species. This tree has rather dense foliage and is bright green in its young growth. The leaves are thin, and broader than others of this species. The branches are

drooping. The flowers and fruits are small. All of the varieties classed as amygdalina have a characteristic odor of peppermint and eucalyptus, but the variety regnans has this in the strongest form. The bark is rough and persistent, but neither like the true stringy barks nor the iron barks.

2nd. Eucalyptus amygdalina, variety angustifolia. This form has very narrow longish leaves, of a dark, dull green, not light, assertive green when young, like variety regnans. The leaf has the veins very obscure, and the odor is mild. Fruit and flowers similar to regnans.

3rd. Eucalyptus amygdalina, variety linearis, has a narrow leaf but not so contracted as the angustifolia. Its leaves are of a bluish green color. The veins are obscure but visible to the naked eye. The bark of these last two is sometimes smooth from decortication and sometimes approaches in appearance the bark of Eucalyptus punctata and even that of Eucalyptus rostrata.

4th. Has a broader leaf, this time thick and with considerably larger fruits and flowers, bark persistent.

5th. Is a form intermediate between No. 1 and No. 4. Baron Von Mueller places both Eucalyptus Risdoni and Eucalyptus coccifera as varieties of the amygdalina. But as both of these trees have a very marked difference of habit and appearance, we may safely side with Bentham and other qualified botanists in giving them specific rank.

In our interior valleys the two narrow leaved varieties are very satisfactory, grow well and make handsome trees. The variety regnans, however, suffers from a leaf blight and does not generally succeed so well. Variety angustifolia has stood severe frosts at the Northern Forestry Station at Chico, unharmed, and does well there. Good

specimens of variety regnans may be seen at the Northwest corner of Orange Grove avenue and California street in a garden, at Paradise Nurseries, Pasadena and at the Santa Monica Station. Prince Truebetskoi thinks that Eucalyptus amygdalina will prove the most efficient sanitary agent of the genus, on account of its foliage containing so large a percentage of oil. We cannot accept this claim, however, until the hygenic and medicinal value of Phellandrene, which in this oil takes the place of Eucalyptol, is ascertained.

The growth of variety linearis is straggling and broadly branching. The foliage in the old trees is segregated in bunches on the limbs presenting a curious effect. Without being much like it, it reminds me of the appearance of one of our cañon sycamores in winter with much mistletoe on it. The bark of some mature specimens is white.

Through the public spirit of the American Ambassador to the Court of Great Britain, Hon. Thos. F. Bayard, I have received a report from the Kew authorities on the Eucalyptus in England. By this report it appears that while the cool, but never very cold climate of the Channel Islands is favorable to various species including Eucalyptus globulus, there are but four species reported that have withstood the temperature of the main English island, and proved really successful trees.

The growth of these species covers a period of 20 years or more. They are

Eucalyptus urnigera, handsome, unknown here.

Eucalyptus Gunnii, does very well with us.

Eucalyptus viminalis, does very well with us.

Eucalyptus coccifera.

This last species we may presume to be either a form

of amygdalina or an allied species. Von Mueller speaks of it incidentally as a probable Alpine form of Eucalyptus amygdalina, which has withstood on the estate of the Duke of Devonshire 7° F. The Kew reports give these four a reliable resistance to frost to 10° F.

I am inclined to think that the variety of Eucalyptus amygdalina, which has withstood such low temperatures at our old Forest Station in Chico, Cal., is also an Alpine form.

Mr. Scharff, at South Pasadena, has some seedlings of Eucalyptus coccifera sent him from Kew. The leaves are opposite and oval on stems. On top the leaf color is a dark Lincoln green, different from the color of any Eucalypti I know. Underneath the leaf is a deep violet-magenta. These seedlings are peculiar in color. The leaves have the peppermint eucalyptus odor of amygdalina, but have not the strong taste of the mature form of this tree. The seedling of amygdalina bears no other resemblance whatever to these young coccifera. It has a grayish green look with long pointed leaves, and no suggestion of the deep undercoloring of coccifera leaves.

The mature Eucalyptus coccifera is described as very glaucous. In this respect the seedlings we have are not like it.

EUCALYPTUS DIVERSICOLOR.

Eucalyptus diversicolor, commonly called the Karri, is the close competitor of the peppermint tree, or Eucalyptus amygdalina, in size. It is also a giant. The wood of this tree contains a considerable amount of kino and probably in consequence is amongst the most durable of the genus.

Prof. Maiden, however, informs me that many valued timbers in Australia, such as tallow wood, for instance, contain little or no kino.

The leaf is dark green above and paler beneath. The tree in this State varies a good deal, especially in its bark. This is sometimes rough and persistent in large squares, at other times smoother from partial decortication. Two trees standing together at Scharff & Shorting's Paradise nurseries, vary sufficiently in time of flowering, habit of growth, ètc., to have suggested them to be of separate species. The Karri has never obtained popularity here, though its neglect does not seem deserved. All the specimens that I know both on the coast and inland are handsome rapid growing trees.

The foliage is greener and more attractive here than that of most species. A Karri in my garden at Santa Monica has made a large tree but it has proved to be brittle. Twice it has lost portions of its top from winds that had no effect on the other sixteen species about it.

To cap the climax of these accidents an electric company chopped off another considerable portion to suit their sovereign convenience. I do not think that this company will try this sort of thing very soon again. But its congeners have a free ax for our road trees. Miles of these trees where wire lines run have the mark of their vulgar vandalism.

Our public officers are as blind to this business as they are to the distressing frequency with which common-souled people have chopped out sections of ornamental shade trees on our roads. Sometimes these choppings are for firewood, sometimes from a mere whim and at others for the purpose of the substitution of some other tree.

The most beautiful as well as the hardiest of our road trees is the feathery green-foliaged scarlet-berried pepper (Schinus molle). I have seen persons with a few feet of road frontage chop out superb specimens of this beautiful tree from a planted and established roadway of them. Then they would put in some short lived grevilleas, some palm or other tree.

Even in cases where a local substitution was of a handsomer tree the effect of such a piece of work could only be ugly, spoiling the effect and force of the general shaded roadway, breaking the unity in time and line beauty. A tree-shaded roadway is always effective, no matter what the tree is, providing the plan of planting is harmonious. Amongst the streets planted to shade trees in Santa Monica by Mr. J. W. Scott at the laying out of that town many years ago, is Nevada avenue. This avenue was planted with Eucalyptus globulus, which, owing to the favorable climate, has made a specially satisfactory growth. The avenue, as a whole, had a beauty due to the large size of the trees and the dignity of its harmonious planting. Yet, from time to time, one lot owner or another has cut out the blue gums; in one place planting peppers, in another grevilleas, in another palms, until now it is a broken medley of little and big, old and young trees of inharmonious character without force or effect. Both the lot owners and the authorities were doubtless well intentioned, but were aesthetically blind.

There is no more beautiful and no grander road tree than the American elm, still this fact would not justify, nor even excuse, a man for cutting, on his own small frontage, four lindens, in such an avenue as that near Weisbaden, to replace them with elms. The cutting out

of live oaks in the cemetery drive at Savannah for the same purpose would be an equally barbarous vulgarity. Nor would a personal preference for the oak excuse the cutting of ancient elms in a New England village to plant acorns.

Some day we may hope that ignorance in road tree matters will be less, and that where it does exist a check will be found in an honest, firm and efficient administration of the public interests.

The timber of the Karri, under Australian experiments, was found tough, even stronger than English oak, but is reported much affected with star shakes. It is one of our most rapid growers.

Dr. Aberg, in his experiments on the Rio de la Plata, Argentine, found the Karri the fastest grower of any species, with corymbosa and globulus second, and leucoxylon and siderophloia third.

In my plantations at Santa Monica I found the Gunnii the fastest grower for the first few years. In the San Gabriel Valley, in the earliest plantation of Eucalyptus near the present East San Gabriel Hotel, the blue gums are broad spreading and very large, some nearly 200 feet. Amongst them is one Eucalyptus Gunnii, thrifty, but not over 50 feet high. The trees are all on a roadway.

Thus it will be seen that the fastest growing trees, such as the acacias, grevilleas, and of the Eucalypti, Eucalyptus Gunnii amongst others, cannot, from that fact, be relied on to maintain their early, high-growing speed. Eucalyptus globulus is, indeed, a phenomenon in this way and in favorable locations will maintain its rapid growth up to eighty or one hundred feet. Its fastest growth is in youth, while our lovely red live oaks spend their first four or five

years from the acorn in thoroughly establishing themselves. While these oaks never grow very fast till after the fifth year, their progress in my experiment has been satisfactory. This different time of fastest growth may be due to the different type of root growth. The blue gum is naturally rather a surface root tree, while Quercus agrifolia is a deep root delver. These characteristics might indicate that the blue gum is a native of moist regions and our live oak of dry ones. Frequently blue gums blow over because of their shallow hold on the soil. I have never seen such an accident befall Quercus agrifolia. This oak is my favorite tree, but the best growth from the acorn in my plantings is twenty-seven feet in twelve years.

Quercus agrifolia has, locally, the widest range of any of our Southern California trees. It luxuriates with the rich-leaved alder and the willow, by the springs, courses down the sandy torrent beds, hand in hand with great sycamores, even to the spray line of the sea, wanders out into the open plain with the gnarled and thorny blue oak, and then, like some sweet, confiding maid, ventures with all her beauties far into the dark cañons, where, amongst the graceful fronds of the fern brake, where the oblivious sing-song of some murmuring brook goes on in endless monologue, she, half hiding in the heavy shades of green, now greets the haughty golden oak, or gives a hand to some hardy rough browed spruce that has dared the dangerous cliff descent to the valley's verge for such a lovely sweetheart's sake.

Eucalyptus diversicolor has suffered more than usually from a general botanic name confusion. Outside of Australia it is almost everywhere called Eucalyptus colossea. This case of confusion grew out of giving specific rank to

the extraordinary vigor, size, and somewhat changed appearance of this tree in its favorite moist mountain gorges.

It seems to a layman, or, as we might say with colloquial aptness, to a man up a tree, as though much of the re-naming and resulting confusion in botany might be obviated.

There should be a statute of limitations on names, so that those used and accepted for a certain time should remain fixed at least as to honorary specific designations.

There should also be some regard to decency and the canons of good taste.

For a long time we had a beautiful American magnolia, labelled very satisfactorily, "Magnolia grandiflora." It seems that some person delving in obscure and musty records found a prior name, or one claimed to be so, and now we suffer under the affliction of Magnolia foetida. This in plain English is "stinking" magnolia. This ill-smelling name I, for one, will never accept.

Several trees have "Pseudo" set in their names, as Pseudo-tsuga taxifolia, our old Abies Douglasi, and Robinia Pseud-acacia and acer Pseudo-platanus.

It has always ruffled my temper to see accomplished naturalists so little in touch, as shown in such names, with the grand mission of nature. To accuse nature of falsifying in such matter as our Oregon pine, the greatest of all timber trees, is the sign manual of a congenital defect in the rut-bound bis-baptismal sponsor.

Records on the durability of Eucalyptus diversicolor timber vary a great deal, and are perhaps due to the different conditions of soil and humidity where the trees grew from which the timber was taken. Mr. Walter Gill, the accomplished conservator of forests of South Australia, calls

special attention to this variability in the character of Eucalyptus woods. Eucalyptus marginata has been noted as varying to the extent of 33 per cent. in its contents of kino. Our yellow pine (Pinus ponderosa) has a wide range in the west, and varies in its timber value with its situation. Probably all trees do the same.

The age of trees, and their vigor of growth for their age, have much to do with the character of their timber. The season of the year when they are cut and the curing afterward should also be investigated. I can remember an opinion that was often acted on that the Southern live-oak could only attain its highest value when seasoned under water.

It may be seen, if this opinion be presumed correct, that tests of live-oak differently cured might give results not uniform as to the value of the timber.

Another source of possible error is the laxity as to exact identification of the species of trees from which timber for testing is taken.

Some years ago piling of "Eucalyptus marginata" was brought to San Francisco and tested on the sea wall. In one year it was riddled with teredo. I saw the piles after they were pulled and I could not believe that they really were from the Jarrah, a world-renowned teredo and white ant resistant.

The precaution taken to obtain marginata timber from its best districts or even to be secure that it was marginata at all were in my opinion inadequate. Specimens of Karri may be seen at Paradise Nurseries and at Forestry Station.

EUCALYPTUS GUNNII.

Eucalyptus Gunnii is a green, attractive looking and rapid growing tree. It is one of the best frost resisters of the genus, but contains only a small amount of the oil and active principle of the Eucalyptus. It consequently can not be ranked high as a sanitary tree. The foliage, or rather the leaves individually are wavy or kinked, suggesting the mild application of a fluting iron.

The sap of this tree is reported to be used by settlers in Australia for a fermented drink resembling cider. It is doubtless due to this fact that it has received its common name of cider gum. It is often a very fantastic grower in California. I have a tree of this species in my Santa Monica garden that has bent entirely over and sweeps the ground with its branches. The timber is not valuable. Specimens can be seen at Scharff's, at the Forestry Station, and one old one opposite the East San Gabriel Hotel.

EUCALYPTUS POLYANTHEMA.

One of the species that has seemed to me particularly attractive is Eucalyptus polyanthema. This is called the Den tree in Australia from a native name, and perhaps more often red box from the color of the timber. The wood is very durable.

The tree usually of moderate size, sometimes reaches a height of 250 feet. It is native to rather dry rolling country.

The foliage is for the most part oval and plentiful, with a white blue silvery tinge. The branchlets profuse in flowers,

from which its name is derived, are still more silvery with the same delicate powdering as that of the young blue gum. Indeed it is far more a harmony in silver-grey than any plant I know. The artichoke, the African honey plant, the Leucodendron argenteum, the Deodar cedar, and the young blue gum are more silvery or blue-grey, but the polyanthema has the advantage that throughout its silvery foliage are scattered the delicate flower panicles still more silvery. The Leucodendron argenteum is the most pronounced tree of this sort. It is however stiff and hard to raise from seed.

In seeking for a silver-grey foliage effect the olive should never be forgotten. It is more purely a silver-grey than any tree I know, except the silver Leucodendron. It surpasses this tree on account of its hardiness and the charming grace of its growth in youth and its character and individuality in age. The olive in California is a handsomer tree than it is in Europe.

The Himalayan silver cedar has a distinctly green base. It is a beautiful tree. The silvery Eucalyptus that I know, as I go over them in my mind, have their assertive blue or silver coloring, mainly due to a sort of powdery exudation. The base color of their leaves is usually a dull green. Some have that silvery coloring in youth only, as the blue gum, with a persistence in age on the fruit alone, some have it more in age, as variety pallida of sideroxylon some have it more at one season than at another, as in Eucalyptus polyanthema, and others do not have it at all.

The drawback to the olive is its proneness to attack by black scale, a parasite that takes its name from the olive. The black scale is ugly in itself and besides exudes a gummy substance that falls on the foliage and branches

below it and becomes at once the home of a black fungus. This materially injures the appearance of the olive and markedly diminishes, and even destroys, its normally beautiful silvery foliage.

The lace wing fly, or one of the ladybirds has, with me, destroyed the black scale on my olives. The scale is not exterminated, but persists in such small number as to be unnoticeable. It may be that some other enemy helps keep the scale down, but the little bored holes in the scale show the lace wing's work to be important.

The timber of Eucalyptus polyanthema is useful, being very tough and hard to split. The tree is a moderate grower, and it is reported by Von Mueller to have withstood the out-door temperature of Kew. To these material advantages it adds a unique beauty. The habit of growth of this Red box is also graceful, each leaf being attached to the branch by a slender stem.

This tree at Mr. Scharff's, in South Pasadena, has done well, and the specimens at Santa Monica are vigorous and attractive. It deserves a wider attention than it has received. The seeds can be obtained from any of the trees named.

EUCALYPTUS LONGIFOLIA.

Eucalyptus longifolia is a persistent barked, moderate sized tree, native to the New South Wales plains, between the Coast and the Blue Mountains, which climatically cut that portion of Australia in such distinct divisions. It is called the Wooly Butt and is mainly used for fuel. It is named for its exceptionally long sickle shaped leaves which at times are found even over a foot in length. Here

the leaves have not shown unusual lengths. The tree grows very well with us and is a profuse and nearly constant bloomer. The flowers carry a full supply of fine nectar. Prof. A. J. Cook, our distinguished authority on the apiary, calls attention to the value of this tree in bee culture. He has observed it at Claremont, on the foothills of the Pomona Valley, and speaks highly of its constant popularity with bees.

Bees are not themselves popular with fruit men in California. Vast quantities of fruits are dried with us each season and no inconsiderable toll on these is levied by the bees. Bees, however, we have always with us, when not domesticated and the toiling serf of man they are wild and, at least along the mountain ranges, seem as numerous and damaging as when housed and made useful.

The greatest injury is done by bees to the extra early and extra late drying fruit. Probably they take more sugar where the sunniest ranch lands are filled with drying apricots as golden as the poppy or with peaches, but we do not then feel it so much for the percentage of loss from these large quantities is small. When it comes to such fruit as pears, that seem specially attractive to bees, there are districts here where we can not dry them in the open. The bees eat them up. E. Bonine, at Lamanda Park, had a painful experience in this line.

Prof. Cook speaks of another species of Eucalyptus from Riverside, not yet identified, which is reported as an apicide. It seems both attractive and fatal to bees, like a Parisian Phryne to an uncharactered richling. I am afraid that if the fruit men get hold of this species there will be many a bee-break in the drying districts. I have no confidence in the accuracy of this report.

Specimens of Eucalyptus longifolia may be seen at Claremont, also opposite the Throop Polytechnic and next to a church, Pasadena, and in the City Park, Nevada avenue, Santa Monica.

Eucalyptus Sideroxylon and Eucalyptus Leucoxylon.

These two have been ranked as one species by Von Mueller and Bentham, but seem to warrant separation.

Eucalyptus sideroxylon is a great tree for our dry interior valleys. It is a handsome tree at Scharff's and Shortings, and at Santa Monica, with blue grey foliage and scarlet flowers. In South Australia the smooth barked Eucalyptus leucoxylon is amongst the most successful in the trying interior forest stations of that colony. The flowers of both these species vary in color, from pale yellow to flesh pink, and, as we may note in the specimen cited, they sometimes tend to red. They vary also in the persistence of the bark. As the common white gum in the open country most of the bark peels off, while as the Ironbark on the stony ridges the bark is persistent, of dark color, and deeply fissured. Some specimens were introduced here long ago as Eucalyptus sideroxylon, or Ironwood.

These two species or two varieties of leucoxylon, the one usually branching into several stems or branches near the ground, with grey smooth bark, pink or white flowers and pale colored wood; and the other (sideroxylon) single stemmed and stocky in growth, with generally red flowers, dark rough red bark, and red wood seem to deserve specific rank in each case. Besides these points Prof. Maiden has noted the marked difference of the kino from these trees.

Eucalyptus leucoxylon or white gum or South Australian blue gum is a native of South Australia, while Eucalyptus sideroxylon is a native of New South Wales. When I speak of the ornamental leucoxylon I refer to what we introduced as Eucalyptus sideroxylon. Von Mueller does not recognize this as a species, but I think that it again will be thus ranked.

Bentham's Eucalyptus leucoxylon var. pallida is doubtless our silver leafed sideroxylon. We have here varieties of leucoxylon or sideroxylon as follows:

1. The white barked branching South Australian form. This tree can be seen in great vigor at Santa Monica Heights; flowers white and pink.

2. Rough persistent barked variety, with dense green foliage and pink flowers, a profuse bloomer, and a sub-variety with white or yellow flowers. The white flowered ironbark at Santa Monica is a shy bloomer. A splendid display of the green foliaged pink flowered ones may be seen at Ellwood, Santa Barbara.

3. Rough persistent red barked, red flowered and with silvery grey foliage. Also a profuse bloomer.

This tree can be seen at the Paradise Nursery, Pasadena, and at the Santa Monica Forestry station.

The most recent information I have from Australia indicates that these rough persistent barked forms are now ranked as Eucalyptus sideroxylon. The original name is thus renewed for the ironwood.

This tree is usually of moderate growth but is reported exceptionally at 200 feet. In the bottom lands of Victoria the smooth barked form, or Eucalyptus leucoxylon, is the companion of Eucalyptus rostrata. It does well in moist tropical climates as well as in the dry interior of por-

tions of Australia. Its seedling, of S. A. form. has narrow or more often nearly cordate opposite sessile leaves. In its early and rather vine-like habit of growth it reminds one of the viminalis seedling without being like it. The wood, like that of many Eucalypti, is heavier than water. Eucalyptus sideroxylon var. pallida is a beautiful tree. The grey of the foliage sets off the striking pink of the flowers. The stems of the leaves are of similar color. Pink is the nearest description for the color, but it is Australian pink. From our limited local experience we are self-satisfied enough to term many of the Australian growths fantastic. We might say this also of some of its flower colors. The sideroxylon flower for instance is neither red, scarlet, pink nor magenta, but a sort of mixture of all these colors. The nearest name for it is that which a nurseryman gave, "a madder pink." The color is brilliant. The bark on nearly all our specimens is hard, persistent and deep iron red. The trees are attractive, indeed handsome.

The name "leucoxylon" means white wood, and is very appropriate to the tree Eucalyptus leucoxylon as found at Santa Monica. Eucalyptus sideroxylon or the iron wood produces a straight bole and a more valuable timber than Eucalyptus leucoxylon. In Eucalyptus leucoxylon the flowers are nearly always three to the umbel. In Eucalyptus sideroxylon the flowers are usually more numerous. In fact the white or lemon-colored flowers are the only ones of sideroxylon that I have observed in threes. The pale yellow flowers with their prominent crimson style are attractive, but too few to satisfy us. The shape of the fruits of Eucalyptus sideroxylon vary considerably. The fruits of Mr. Cooper's trees are nearly if not quite hemispheric, while the fruits here are generally elliptical. The fruits of Euca-

lyptus leucoxylon are larger than those of Eucalyptus sideroxylon but resemble them here more than our sideroxylon fruits resemble those at Mr. Cooper's. There is no possibility of confusing these species when once seen growing. The one is a spreading white barked tree with comparatively scanty foliage, very persistent fruits in great quantities, and withal rather pleasing—while the other has a rough rusty or dark colored bark with dense foliage, and grows in an erect concentrated form, and is always attractive and sometimes beautiful.

EUCALYPTUS MICROTHECA

Is reported the most suited of the whole genus of tree size to torrid desert conditions. Mr. K. H. Bennett reports it as reaching a height of eighty feet, and a diameter of four feet. Von Mueller gives more of the native names of this tree than of any other, viz.: "Tangoon" in Riverina, "Callaille" on the Murchison River, also "Yathoo" and in Queensland "Coolybah."

It is a very important tree to the natives, for it is mainly from the roots of this Eucalyptus that they obtain water when all other sources fail. The method of obtaining water is reported by Von Mueller as follows:

"The lateral roots are lifted by the natives with sharp pointed sticks or thin spears to the surface from about a foot or less in depth and to a distance of fifteen or more feet from the tree, the overlying earth when necessary being removed by wooden shovels The root is then cut into pieces of about 18 inches in length then the bark is peeled off; if the water, on placing these fragments vertically, does not at once commence to ooze out spontaneously, the process is

expedited by blowing vigorously at one of the ends of the root pieces ; roots of the size of a man's wrist are the best for this operation."

"Mr. Bennett obtained in most favorable cases by these means a great pot full of water in half an hour and found it beautifully clear, cool and free from any unpleasant taste. Mr. J. Cairns refers also fully to the water-yielding Eucalyptus as weir-mallee. The courageous explorer, Edw. John Eyre, gave likewise an account of this process, for obtaining water. Roots from depressions in the ground yield the fluid most copiously. Main roots near the stem are not sufficiently porous for obtaining water therefrom. Messrs. Muir saw desert Eucalypti also used widely in Southwestern Australia for obtaining drinking water from the roots, the aboriginees having entirely to depend on this source for water in many of their hunting excursions, the roots chosen being about one inch in thickness, the surrounding soil being often dust dry."

Eucalyptus populifolia and the mallee-scrub are also known to give water from the roots, but to a less extent than microtheca.

Prospectors in our south-western deserts use various kinds of cactus to obtain water. One of the best of these is a tall columnar looking cactus. The method I have heard of as used in this case is as follows:

A cut is made near the base of the cactus something like a turpentine blaze, square and cut out at the bottom. This depression rapidly fills with water, which, though good, is not entirely free from an acid taste. Stock has been saved in Southern California in the old days by burning off the spines of the Tune cactus and then giving fragments to the cattle to chew.

Many of our animals inhabiting the desert or waterless plains near these have no known means of obtaining water for long seasons. Sheep on green pasture are not usually watered, I am informed. I recollect the surprise I felt years ago in observing the small amount of water used by the Bedouins of the Libyan desert when travelling. It would seem from this that some of the animals and even some men can do well on a very small amount of fluid.

Many dreadful deaths have happened from thirst on the burning Colorado desert. Probably very few of these would have occurred had the travellers known all of the resources about them.

The death of all the members of an emigrant train together with all of their animals from thirst, in the Desert of Death Valley, took place on a part of that arid waste where water was only eight feet below the surface of the soil. A few strokes of the shovel would have saved the whole party.

The seeds of microtheca are small. While some of the gums have good sized fruits like the large-leaved, wing-seeded Foelsheana, of Port Darwin, or like calophylla, (the kino-charged guarantor of health, not assainitor but judicious selector of healthy sites,) the Eucalyptus as a rule has small seeds. Small or dwarf species are the usual harbors of exception, but the giants of the genus, like the Karri, regnans, globulus, viminalis, etc., all have small seeds. So with us the giant sequoias have minute seeds, while the Pinus coulteri, the piñon, the Torrey pine, the mesquit and our oaks have large generally edible seeds. I know of no Eucalyptus seed that is edible, though some of the larger ones may be.

I have found so many of our arborescent species, whose

habitat is in dry or desert location, with large well stored seeds, that I have thought this useful characteristic an evolution forced from the severe conditions these species must contend with. Now comes this desert tree from Australia with such small fruits and seeds as to get its name from this characteristic.

The range of this tree in Australia corresponds in a general way with that of our very valuable desert mesquite (Prosopis juliflora.) The mesquite is valuable for forage, fuel, food and honey. I have seen several large specimens of the tree in Southern California, notably two at the Purcell place, San Gabriel. I think that the tree should be planted in Arizona. While perhaps a little slow at first, it is sure to succeed generally in that section of country.

The specimens at San Gabriel were attractive with feathery foliage suggesting certain acacias.

Microtheca is a tree well worthy of extensive trial in the more trying situations of our southwestern country. I am unable to find any record of its planting or rate of growth. It appears to be a surface root tree and in this respect the opposite of our Californian valley oaks. These trees send their roots straight down and quite out of the way. The cactus and yuccas have very short roots that possess an extraordinary capacity of seizing a supply of moisture from the semi-occasional torrential rains of the desert region, and of holding the same for long periods.

Thos. A. West, a mining man of intelligence, tells me that some years ago he brought a young columnar cactus from the Colorado desert and hung it under the mantel shelf of his sitting room fire place at Glendora, surely a dry and trying place for any plant.

For three years this cactus suffered but little in appear-

ance, every January putting out a few rootlets as though seeking moisture, and then died.

These desert plants are so organized as to withstand several years of drought. I presume that the Australian Mallee, Eucalyptus microtheca and other species of the arid interior must have the same power, and if the water for their existance be not stored in the body of the plant as in Agave, cactus, etc., it will be found in the roots.

EUCALYPTUS CORNUTA.

Eucalyptus cornuta, the "yate," is a very attractive, graceful tree. Its foliage is greener than that of the blue gum and tends to persist in the round or oblong form of leaf. It is a rapid grower and resists drought on light soil better than Eucalyptus globulus or Eucalyptus viminalis. Eucalyptus cornuta is one of our hardiest and fastest growing Eucalypti. The bark is a pleasant light drab color and nearly smooth. The tree grows tall, has great vigor in our valleys, and the timber is valuable. I have observed old specimens with only scant amounts of fruit.

As a rule the Eucalypti are free fruiters and many of them carry their profusion of seed boxes so long as to form distinct disfiguration. In habit this tree is low branching and is consequently not perfectly suited for a road tree. I planted about a mile of road with these trees

at Santa Monica. Fortunately it was a double row plantation on each side of the road with Eucalyptus globulus on the outside. In this combination it made an attractive avenue. Alone, however, it might have been unsatisfactory. While it does branch low the Yate makes a large handsome tree with plenty of foliage. Mr. Scharff's specimen is one of his best trees. The growth of one in my Santa Monica garden has been exceptionally satisfactory. The flowers are so large and close in the umbel that each umbel looks like a large single pompon flower of delicate light green or light straw color. Its name comes from the long horn-like cap of the flower.

EUCALYPTUS LEHMANNI.

A very near ally of Eucalyptus cornuta is Eucalyptus Lehmanni. The latter is shorter, has larger fruits and flowers and is specially distinguished by having the fruits on each umbel all confluent forming a large ball that suggests the wasps nests of my boyhood experience.

Large Eucalyptus Lehmanni can be seen at Ellwood. There are a few about Santa Monica, especially at the Forestry Station.

Besides the points named the leaf of this species is shorter and thicker than that of Eucalyptus cornuta. It is not so attractive a tree as the Yate. The effect of the persistent large balls of fruits is very peculiar.

EUCALYPTUS DORATOXYLON.

Eucalyptus doratoxylon is a slim, but very pretty growing tree. It is the favorite source of spear wood for the Australian natives and derives its common name from this reason.

This tree, with Eucalyptus pilularis which is still more elegant, and one might say stylish, should be marked as useful for special places in ornamental plantings. The wood of both trees is tough, durable and useful. A fair specimen is growing at the Heights. Another tree of similar tall and slim habit is

EUCALYPTUS MACULATA VAR. CITRIODORA.

This is a fast growing tree of tough and durable timber. The leaves when crushed have a strong lemon scented odor suggesting hair oil—but withal pleasantly. The young growth is hairy and the leaves spring from the stems with about one-quarter of their length inside—that is, the stem, instead of having the leaf grow from its end has the leaf over it, one-quarter on one side and three-quarters on the other; what botanists call peltate or shield like.

I planted a citriodora in an old clump of trees in my garden for the sake of its fragrant leaves. It grew so fast that it soon passed out of hand reach and then out of ordinary ladder reach. It is now about sixty feet to the first limb. The stem is straight, smooth and of a warm grey color with a smallish head of sickle-shaped branchlets that respond to the breezes' slightest breath. In my tree clump the citriodora now stands as a steeple does to a church.

Last spring two blue grey mountain squirrels fell in love in this little grove. While Miss squirrel sat in an olive amongst scarlet bignonias, her fiery-hearted swain showed daring feats in the bending Eucalyptus limbs, swinging from one to another, and then making wild leaps down into a camphor tree. I enjoyed the courtship perhaps as much as the squirrels, and paid them with a blind eye to their orange eating.

Nurserymen here have promoted the citriodora to specific rank. As far as the foliage goes it certainly deserves a name of its own, for the leaves of Eucalyptus maculata proper are reported to be entirely without the fragrant odor of Eucalyptus citriodora. I know of no maculata other than those of this variety in California.

The leaves of citriodora properly cured make a pleasant sachet or fragrant sofa pillow.

The timber of this tree is very valuable. A still more fragrant foliaged tree is Eucalyptus Staigeriana, the lemon scented ironbark. I know of none of these here. Some of the finest old specimens of Eucalyptus citriodora are at Ellwood. In these the foliage is in great drooping clusters, giving a unique effect with the smooth white bark. The foliage is greener than usual in this genus.

EUCALYPTUS GOMPHOCEPHALA.

Eucalyptus gomphocephala is a thick, green foliaged tree from Western Australia. J. Ednie Brown's reports from Adelaide gave me great expectations from this tree. At the Santa Monica Forestry Station it has proved a comparatively slow grower and shy fruit bearer. The calyx or seed urn has an exceptionally large lid, from which its name is derived. This means peg head.

The south Australian reports show small plantings of this tree in recent years.

It is a stocky tree with symmetrical head and plentiful foliage. Its timber is very valuable.

The only large Eucalytus gomphocephala I know are at Mr. Cooper's Santa Barbara ranch (Ellwood). There are several handsome tall ones there in a rich little bottom land. The timber is valuable. The young seedling is of a light bright green color, a point one might not consider in some other plants that do not vary so much from the ordinary in their color and forms as the Eucalyptus do.

EUCALYPTUS OCCIDENTALIS.

A Western Australian tree that we have tried that has grown well is Eucalyptus occidentalis.

The characteristic form of this tree has a bell-shaped calyx tube with sharply protruding valves and foliage very similar to that of Eucalyptus cornuta. The flowers of this form are white or creamy. There are very few of these in

California. There are some old ones at Ellwood, some at the Santa Monica Forestry Station and another at the Heights. The timber is valuable and the tree resists drought well. The foliage is quite thick and bunchy. There is another form of this tree that is very ornamental. We have called it Eucalyptus occidentalis just as we have called Eucalyptus Kirtoniana, Eucalyptus robusta, when it was at the least a variety, and Eucalyptus sideroxylon, Eucalyptus leucoxylon, but this latter confusion is due to our great Australian botanist. The form of Eucalyptus to which I allude is between Eucalyptus occidentalis and obcordata and it might just as well be called a variety of obcordata as of occidentalis, if not given specific rank.

It varies from Eucalyptus obcordata in having the umbel stalk less twisted, less broad and the fruit less angular and the border not so contracted; in fact it is less exaggerated. The foliage is a darker green and the leaves more irregular in shape, having the mid rib often all on one side, than obcordata. It grows to be a taller tree, for our obcordata is more of a bush. Eucalyptus obcordata has the calyx sessile to the stalk while our Eucalyptus occidentalis, which for convenience I shall name var. Californica, varies from it in having long stalklets. Var. Californica varies from Eucalyptus occidentalis in having broader stalks and stalklets, angular fruit, not bell-shaped but urn-shaped, and larger; the leaves thicker, greener, oblong or round crenulated and irregular and scattered instead of bunched. The leaf color is a Lincoln green. The flowers of Eucalyptus obcordata are of a dull inconspicuous red; those of Eucalyptus occidentalis white, while those of var. Californica are of a brilliant warm red which against the dark green leaves and with the creamy white stem produce a charming

effect. There is also a var. Californica with a yellow flower; this is a companion tree of Eucalyptus rostrata in Arizona. These two alone thus far being thrifty under its fiery summer sun.

The yellow-flowered var. Californica can be seen at the Paradise Nursery and at Santa Monica Heights, also at Ellwood ; the red-flowered one at the Forestry Station.

Eucalyptus occidentalis var. Californica is a very attractive tree. The specimens planted by me at Santa Monica Heights are amongst the thriftiest and handsomest trees there. The bark is mottled white in effect from the small scaling off of the old outer brownish layer. The branches are very brittle. The red flowered var. Californica is worthy of attention as an ornamental, clean and thrifty moderate sized tree. It is a perennial bloomer.

EUCALYPTUS OBCORDATA.

This is a small, rather ornamental, thick-leaved, light green colored tree, with profuse very dark red flowers. The name comes from the heart shaped leaves. In Santa Monica this shape is exceptional in the larger trees, but general in some of the shrubby forms. We have a shrubby form of both obcordata and occidentalis.

EUCALYPTUS HAEMASTOMA.

Eucalyptus haemastoma (red mouthed, from the red rim of the fruit) is a tree that was introduced into Santa Monica in 1876. It has done well and become a medium-sized tree with rather spreading top. The bark is rose-grey and smooth with us. The wood makes a fair fuel, but is otherwise inferior. I can see no reason for the introduction of this tree except that it was amongst the earliest described species.

There is another very tall tree in the old park at Santa Monica, with smooth white bark planted at the same time. This tree is so tall that we could not reach the flowers. and only recently identified it as the smooth barked Eucalyptus viminalis.

EUCALYPTUS OBLIQUA.

Eucalyptus obliqua (messmate of Victoria and stringy-bark of South Australia) is widely scattered throughout Southern Australia, and is one of the principal sources of the local timber supply. Its wood is easily worked and it grows gregariously. Thus economy of transfer and plant is possible.

The tree is reported as a rapid grower, sometimes reaching 300 feet. My experience with it has been disappointing. A number of them planted in my garden at Santa Monica were only exceeded in unsatisfactory growth by Eucalyptus marginata. Eucalyptus Gunnii, viminalis,

rostrata, pilularis, diversicolor, siderophloia, cornuta, calophylla, obcordata, corynocalyx, robusta and amygdalina, in the same place, did remarkably well.

The garden is near the coast and, especially where the obliquas are, is exposed to the summer trade wind. They all lean away from the breeze, in this respect being specially different from Eucalyptus robusta and Eucalyptus cornuta on either side.

There were a number of these trees on South Main Street, corner of 14th, in Los Angeles, that showed a fairly good growth. All except three of them have been cut down and these three have been topped by a telephone company. Thus the only street planting of Eucalyptus obliqua that I know is not a very satisfactory illustration of what this tree will do when thus used. The specimen of this tree at the Paradise nurseries, South Pasadena, is a handsome tall tree, with dark green glossy leaves, that will average well with the other Eucalyptus species planted there.

There are good specimens of Eucalyptus obliqua at the Forestry Station, Santa Monica, and at the Heights. The bark is employed for primitive roofing in new settlements.

EUCALYPTUS MACRORRHYNCHA.

Eucalyptus macrorrhyncha is a sufficiently similar tree native further west to go by the same popular names as obliqua. We have some growing but cannot yet tell whether it does better here than Eucalyptus obliqua or not. It is a very inferior looking tree, being with us irregular and shambling in growth.

EUCALYPTUS HEMIPHLOIA.

Eucalyptus hemiphloia is recommended by Mr. Walter Gill for dry sandy situations. I have received from him some seed which are being grown by the Paradise Nurseries of Pasadena. The seed has sprouted poorly, and "damped off" so that we shall raise very few. Von Mueller's account of the native habitat of this tree indicates that in the moister coast section it makes a tree of 150 feet with pale colored timber. While it thrives in dry interior sections in these situations it tends to a more stunted habit. The best specimen of this tree is at the Paradise Nurseries. Others may be seen at the Santa Monica points, Forestry Station and Heights. It is reported an excellent timber and fuel tree.

Prof. Maiden informs me that Eucalyptus hemiphloia is taken by the Australian squatters as a reliable indication of good land and good pasture in New South Wales. That would not seem to agree with a tree satisfied in sandy situations.

We cannot tell much about this tree as to its utility for our sandy washes in which I especially hope for good results. I am each year growing more into the opinion that our own balm of Gilead, sycamores and the red live oak, are the best trees for these hard places.

Our sandy torrent beds far out into the plains beyond any surface flow, other than that of storm waters in the rainy season, are now generally populated with these three trees. Q. agrifolia thus situated seems far the most vigorous, with the balm trees next. The sycamores look more and more unhappy the farther out into the dry plains you go. The easiest tree to start in the washes is

the native cottonwood, or balm of Gilead. The cotton-wood seedlings come up in the washes oftenest; next are the oak trees. Sycamore seedlings are very rare in the interior cañons and washes, but extraordinarily numerous in the Santa Monica cañons every few years. Often the young trees start, especially the oaks, and then die from the prolonged drought of the dry season. The indications from these torrent bed growths is that our climate is slowly changing and becoming drier. Another suggestion in this line is the almost entire absence of greasewood seedlings. These bushes, the roots of which make such fine fire wood, cover large areas in our southern foothills on granitic formation. The absence of reproductive power is similar to that of our high type Americans who seem to be progressively nearing absolute sterility and the extinction of the American as an historical entity.

EUCALYPTUS INCRASSATA.

Eucalyptus incrassata is one of the growths forming the mallee scrub. It is a tall growing bush with leaves heavily charged with oil and reported as growing on sandy interior ridges in Australia. This, with the other mallees, forms a main source of the supply of Eucalyptus oil. A great advantage of the mallee scrub as a source of oil is the ease with which the foliage can be gathered and the capacity these have of sending out new growth. Where sandy conditions prevail, or in dry hilly sections these mallees may be found valuable as a source of Eucalyptus oil.

Eucalyptus oleosa, Eucalyptus gracilis and Eucalyptus

uncinata are the other species usually classed as constituting this scrub.

They all stand drought, heat and severe conditions. The uncinata has long narrow leaves and small semi-ovate fruits. The gracilis leaves are similar and less narrow, with fruit small and even shaped. The incrassata has leaves shiny on both sides, somewhat the shape of those of Eucalyptus gunnii and inclined to be wavy or curly in outline. The fruit of this is larger and usually much ridged, the oblong oval of the fruit only cut off at the end. The forms of these plants vary a good deal at times.

I do not think that any of these mallee bushes are growing in California. In the early days of the forestry work, before there was any money or any station, I distributed some seed of these, but never received any report on them. The parties to whom they were sent are "non est inventus." That system of experimenting with new trees was too scattering to be of service. In our mobile population it was especially inappropriate. Out of the whole of the seed distribution but three records of value were ever reported.

EUCALYPTUS MELLIODORA.

Eucalyptus melliodora does well here. Its timber is hard, durable, tough, but difficult to work. The name means honey scented. It is also called yellow box, and by the Gippsland natives "Dargan." Von Mueller says that while the seedling of this species has scattered oval or oblong leaves, and differs very much from that of Eucalyptus leucoxylon with its opposite sessile longer and

broad based leaves, the mature forms are more difficult to distinguish. He points out the differences as follows:

"Eucalyptus melliodora differs as a species from Eucalyptus leucoxylon (sideraxylon), irrespective of the differences of the wood, in the less deeply furrowed portion of the bark and in the yellowish tinge of its inner layers, in usually smaller leaves, flowers and fruits, shorter flower-stalks and mostly less elongated stalklets, further in more numerous flowers of the umbels with a tendency to a partially paniculate disposition, often in a less pointed lid and in the fruit generally more contracted at the orifice."

The formation which this tree prefers is, I believe, like that of the mission hills about Los Angeles, where it would probably do better in the south exposures than the Juglans Californica does in the northern ones.

The only specimens of Eucalyptus melliodora, with which I am acquainted in California, are at the Santa Monica Forestry Station. It is there a strong vigorous growing tree with plenty of rather light green foliage. The bole of the tree is good and the bark suggests Eucalyptus cornuta. The bark is not at all like either Eucalyptus leucoxylon or Eucalyptus sideroxylon.

EUCALYPTUS PANICULATA.

Eucalyptus paniculata is a fairly tall tree that does well at Santa Monica. There appears to be, however, nothing to very specially recommend it for extensive planting. There are two forms of this tree, if each one be not entitled to specific rank. The one we have is that of the New South Wales coast belt, and is mainly distinguishable

from the variety "fasciculosa" in having persistent rough bark and leaves darker on the upper side than on the lower. The flowers are also larger. In the New England district of N. S. W. the tree is found in a transition state between the two forms.

These transitions and mergings of forms or species in the genus Eucalyptus have a counterpart in some of our Pacific Coast oaks.

EUCALYPTUS PAUCIFLORA.

Eucalyptus pauciflora does well with us. It is a smooth bark comparatively soft wood tree, not generally tall, with a maximum native height of about 100 feet. This tree is one of the Eucalyptus having a wide climatic range. In a dwarf form it is found in the Alpine districts of both Australia and Tasmania. On the higher Australian mountains up to 6000 feet this tree and Eucalyptus Gunnii constitute scrubby forests. It has also an unusually broad tolerance of varying geologic formations.

It is from these causes a valuable tree for experiment in difficult places.

The tree in Australia rarely gives much clear timber, nor does it last well underground.

A peculiarity of the tree is its frequent variation in foliage from the narrow sickle-shaped leaf to a very broad large one dissimilar in appearance. The twigs and infloresence are often covered with the bluish white powder of

the young blue gum. The veining of the leaves and the young branches are found at times a bright red.

The name, pauciflora, does not seem as appropriate as one given by Cunningham, viz.: Eucalyptus coriacea. The leaves are thick and leathery.

EUCALYPTUS PLANCHONIANA.

Eucalyptus Planchoniana grows well at Santa Monica. It is a tree reaching a height of 100 feet. The wood is hard and durable, not easy to split. As the pauciflora is indicated for cold districts the Planchoniana is equally recommendable for very hot dry ones. The fruit is large, rather angular. The twigs are also angular. The foliage is reported to form a better head than that of most Eucalypti. Altogether it is an agreeable form of the genus. The kino from this tree is specially valuable. It is with us a profuse bloomer, but has not proved a rapid grower at Santa Monica.

EUCALYPTUS SIDEROPHLOIA.

Eucalyptus siderophloia is the main source of the Sydney ironbark timber and also of the kino attributed to Eucalyptus resinifera. It is a tree of 100 to 150 feet in height with narrow long leaves and rough persistent brownish red bark. The tree has grown well at Santa Monica where it has rather broad leaves, and proved hardy but has not grown as fast as other trees. The crushed leaves have

a pleasant Eucalyptus odor. It has a habit of growth peculiar to several species of the genus. The tree grows with comparatively short branches that give the effect of wrapping the tree in a close covering of foliage. With us it is not a spreading tree. At the present time, October, several specimens are blooming in the East Side Park, Los Angeles. This point might be worth the bee men's following, for October is here a month light in bee feed. Eucalyptus siderophloia is a peculiar, but in its way an attractive tree. It has decided economic value and could be utilized in landscape work.

EUCALYPTUS TERETICORNIS.

Eucalyptus tereticornis has a strong individual Eucalyptus smell from its crushed leaves in marked contrast to the odor of Eucalyptus siderophloia.

The leaves of the Eucalypti vary greatly in the type as well as in the strength of their Eucalyptus odor. Eucalyptus citriodora or maculata var. citriodora is one of the few having no suggestion of Eucalyptus in its sweet lemon-scented leaves, yet this species has the typical sickle shaped leaves and general Eucalyptus look not possessed by all the members of the genus.

The leaf odor of tereticornis bears the same relation to that of Eucalyptus rostrata's leaf odor as the California Bay leaf does to that of the bay leaf of commerce. The odor o the tereticornis foliage, here at least, is strong, almost rank and verges to the disagreeable. I am fond of crush-

ing and inhaling the aroma of the foliage of nearly all the species of Eucalyptus. The effect is soothing and gently stimulating. But the tereticornis is too rough and strong. A friend of mine has used the leaves of Eucalyptus amygdalina var. linearis in his chicken house and hens' nests and found them a preventative of lice and pests generally. The leaves of Eucalyptus tereticornis used by the same gentleman drove the setting hens from their nests.

I have tried Eucalyptus amygdalina leaves with my chickens with good results. Two out of twelve setting hens, however, deserted their eggs. I do not think that this would have happened had the hens been accustomed to the powerful aroma of these leaves beforehand.

Further study of Eucalyptus tereticornis informs us that the peculiarly strong odor of the leaves noted is exceptional. As a rule the odor of the foliage is nearly identical with that of Eucalyptus rostrata. The tree is of rather slimmer habit than that of Eucalyptus rostrata, which is stocky. It, however, varies a great deal, and without considering the peculiar beak-like flower cap of Eucalyptus rostrata, is often difficult to distinguish from it. The leaves are usually broader than those of Eucalyptus rostrata, but I have seen at Ellwood broad-leaved rostratas.

Eucalyptus tereticornis with us grows something on the type of the white-barked viminalis, but is tall and slender. It has not the wavy and delicate grace of Eucalyptus viminalis, having lank, broadish grey green leaves, heavily massed. It is indeed one of the numerous "awkward squad" of Eucalyptus trees.

Eucalyptus tereticornis makes a good stem though rarely exceeding 100 feet in height.

Its close botanic relationship to Eucalyptus rostrata is

further accentuated by its hardy growth and the durability and value of its timber.

Eucalyptus rostrata, however, possesses all its virtues and is a much more attractive tree.

Fine samples of Eucalyptus tereticornis may be seen at Paradise nurseries, Pasadena, and at Mr. Rindge's garden, cor. Nevada and Ocean Avenues, Santa Monica. At this latter place it is mixed in with Eucalyptus rostratas and the two can be seen together. A characteristic difference of these two is in the flower caps. Those of Eucalyptus rostrata are contracted to a sharp point and curved like a beak, whence the name rostrata. Those of Eucalyptus tereticornis are obtuse, oblong and larger.

EUCALYPTUS EUGENIOIDES.

Eucalyptus eugenioides is a tree attaining about 200 feet in height. It grows gregariously, generally upon poor uplands or on sandy places. It is a valued timber tree of South Eastern Australia. The bark is rough, persistent and useful for mats and primitive roofing. It could be used for cordage. The name is derived from the claimed superior beauty of the Eugenioides foliage to that of most of the Eucalypti. The foliage is denser and greener than is usual in the genus. The seedling of this tree is very attractive. The stem and branches are covered with soft hair, and the leaves are beautifully serrated.

I have been disappointed in the more mature growth of the eugenioides at Santa Monica, not that it is not a fair growth and of pleasing appearance, but that it did not come up to the expectation of its name, description and seedling growth. Doubtless this tree would make a far better comparative record in situations more nearly like its native habitat than the moist climate and rich soil of Santa Monica provide. The young growth is yellow and red at the tips, which against the dark green mature foliage, gives our Fiesta colors.

Von Mueller says that this tree and Eucalyptus piperita have so much in common that it may eventually be necessary to consider them as varieties of the same species.

I do not know of any Eucalyptus piperita growing here. This fact is no indication that this tree is not in California. On the contrary it is probably to be found. I distributed seeds of Eucalyptus piperita with many other species but the records have been lost and the only way now to find any Eucalyptus here is to go on botanical voyages of discovery.

Since writing this I have found a specimen of Eucalyptus piperita. In mature form it is more like Eucalyptus pilularis with smaller and more numerous flowers. Its seedling has oval leaves with stems and is hairy like that of eugenioides while the pilularis seedling has long narrow opposite sessile leaves. Specimens of Eucalyptus eugenioides may be seen at Paradise nurseries, Pasadena, at Santa Monica Heights and at the Forestry Station.

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EUCALYPTUS CORYMBOSA.

Eucalyptus corymbosa is another tree that has not, to my knowledge, been absolutely identified as growing in California although introduced here years ago by me. This tree stands considerable stress of drouth and cold. It is a thick leaved tree with persistent rough bark. The timber contains large amounts of kino from the red coloration of which this tree derives its common name of "Bloodwood."

It is a source of commercial kino. The wood does not make good fuel.

The corymbosa is one of the Eucalypti reported to have scented flowers. In this case the odor is pleasant.

There are several reputed specimens of Eucalyptus corymbosa here. Two of these are at the Santa Monica Forestry Station; but as they have not, to my knowledge, flowered, and as the tree labels at that station are not reliable, it is not possible to say what these trees really are. These specimens answer in a general way to the description of Eucalyptus corymbosa, and are good looking trees of symmetrical growth with handsome dark green foliage.

The test of this tree in the Argentine Republic turned out so exceptionally favorable that I have ordered again from Australia a fresh supply of seeds together with those of Eucalyptus urnigera, Eucalyptus coccifera, Eucalyptus microtheca, Eucalyptus salmonophloia, Eucalyptus miniata, Eucalyptus phoenicea and Eucalyptus macrocarpa. The

last three are mainly desirable for ornament on account of the probable beauty of their brilliant crimson flowers.

The strictly ornamental trees of the Eucalyptus genus are not numerous. The first and for a long time the only one brought here as ornamental was

EUCALYPTUS CALOPHYLLA.

Eucalyptus calophylla, or the beautiful leaved. As an ornamental tree it has proved rather disappointing. The leaves are dark green, somewhat glossy, with the veining often a rich yellow. The bark is rough, grey and persistent. The cream-colored flowers are numerous. The fruit and seeds are the largest of the genus.

This attractive description is somehow not realized in the tree.

We have found it of rather slow growth and in no case here is it very tall. The large fruits persist on the tree and do not help its appearance.

It is, however, a valuable timber tree, being used in Australia for the purposes to which our hickory of the Atlantic States is adapted.

Eucalyptus calophylla does not resist much frost, but does succeed remarkably well in the moist tropics, as at Zanzibar.

Von Mueller speaks of frost burning in the calophylla in the Melbourne gardens, but I have never seen one frosted here. There is reported to be a pink flowered variety which I have not seen. Its introduction here would doubtless renew the interest in this tree.

Its habitat in Australia covers that part having the most equable and salubrious climate of the Continent. Hence the local saying, "To live in a red gum forest is to be healthy."

It is called the red gum of West Australia on account of the large amount of kino it contains. It bears no resemblance to Eucalyptus rostrata, the common red gum.

Specimens of Eucalyptus calophylla are common. The finest one I know is on Santa Monica Heights, below the farm house; others may be seen on Nevada avenue at the Forestry Station, Santa Monica, and at Paradise nurseries.

The fruit of this tree and that of Eucalyptus ficifolia are polished and sold for pipe bowls at a tobacco store on Main street, Los Angeles.

The tree is reported to reach a height of 120 feet, and even 170 has been noted. We have nothing like this to show. Forty-five feet is the tallest calophylla measured here and this is exceptional.

Its nearest specific ally is Eucalyptus ficifolia.

EUCALYPTUS FICIFOLIA.

This tree, rather dwarfish in growth, with dark green leaves and usually startlingly brilliant scarlet flowers, has entirely replaced with us the calophylla for ornamental purposes. It is the most striking looking plant we have introduced of the genus. Nothing, it seems to me, can exceed the strange brilliancy of its flowers. The usual color is nearest that of an English soldier's scarlet coat. This coloring, however, does not seem reliable from Californian

raised seed. The tree was introduced, I believe, by Mr. Scharff. He planted seeds of the trees as they matured at his place. An old row of this planting at South Pasadena has given a different colored flower for every one of these ficifolia. The colors vary from a flesh pink through orange and scarlet to a magenta. The two old trees at Santa Monica both have the scarlet flowers which we expected.

The ficifolia in the ordinary sense of the word is certainly ornamental. The foliage is handsome and the flowers, though garish, are so brilliant and interesting that the tree well deserves a place where striking effects are sought.

To me the grander trees of the genus are far more attractive and I even prefer the peculiar and delicate beauties of polyanthema and sideroxylon to the more assertive coloring of the dwarf.

EUCALYPTUS BUPRESTIUM.

There are several bush Eucalypti at Santa Monica, or at Scharff's South Pasadena place, none of which as yet show characteristics worth perpetuating. The possible exception to this is a shrub of the species Eucalyptus buprestium. This is of pretty rounding growth, at Santa Monica Heights, with small flowers and large fruits. The flowers are reported to contain a fine quality of nectar unusually good for bees. Von Mueller suggests that its

capacity for growing on very sandy places might be used to aid in bringing such situations into subjection.

Mr. Scharff has a large seedling growing at his place under the name of Eucalyptus macrocarpa. This is surely a mistake. It may be Eucalyptus Foelsheana which is worthy of trial on account of its large leaves, but Scharff's tree cannot be macrocarpa. This is to be regretted for the macrocarpa must be a plant of power in producing striking effects. Its leaves are large, sessile and opposite, and the whole bush is covered with a silvery white powder. The flowers vary in color from bright orange to crimson. Such colors against such foliage surely produce wonderful effects. I have several times ordered seeds of this tree without ever succeeding in obtaining them.

EUCALYPTUS MEGACARPA.

This somewhat similarly named tree has a large fruit, but nothing else to suggest the macrocarpa. I know of but one specimen in California. This is a vigorous growing and symmetrical tree that is well worthy of more attention. It blooms and seeds freely at the Santa Monica Forestry Station.

The foliage has a pleasant odor, similar to that of Eucalyptus Stuartiana, and is rather a dark green. It is not reported to be very tall. The tree is frequently found on mountains and seems particularly adapted to granite soil. In Southwestern Australia it is called the blue gum.

EUCALYPTUS PILULARIS.

The Blackbutt is an elegant and rather aristocratic looking tree. The seedling of Eucalyptus pilularis, though somewhat stiff, is very attractive. It often has a purplish tinge in the foliage. The mature tree is of slim and erect growth and is reported to attain a height of 300 feet in Australia. With us the tree is thrifty, but not a very fast grower. Its form suggests one of the uses reported for it in Australia—that of telegraph poles.

Eucalyptus pilularis makes a better steeple effect than Eucalyptus citriodora when planted in a copse. There are a number of these trees on Nevada avenue, Santa Monica. The new growth of pilularis is a warm yellow with the youngest leaves red, and produces a pleasing Spanish coloring. The tree can be picked out from others a long way off on account of this characteristic. It is generally useful as a timber tree.

EUCALYPTUS BOTRYOIDES.

This is an exceedingly handsome and vigorous growing tree about Los Angeles. It was introduced here by the late Mr. Grelek many years ago, but seems to have been lost sight of and forgotten. Eucalyptus botryoides has dark green leaves, paler beneath and generally horizontal. The tree stands city conditions remarkably well. This point, together with its usually symmetrical and rounded

head, make it a specially desirable road tree. Eucalyptus botryoides is also reported as growing on coast sands. I have started an experimental planting in such a situation in South Santa Monica, with thus far most favorable results. It is called a mahogany in Australia. All of the specimens here that I know, except one, have persistent rough bark on the main stem, decorticating only on the upper branches. The exception is a very tall handsome tree at the Paradise Nurseries, Pasadena. This tree sheds its bark on the main stem also. This decorticating of the main stem is said by Von Mueller to be one of the characteristics separating Eucalyptus saligna from Eucalyptus botryoides. Scharff's tree, however, is exactly like the other botryoides in bud, flower, fruit and foliage and not like saligna in its fruit. The bark on the main stem is shed like, and appears similar to that of the upper branches of the certain specimens of Eucalyptus botryoides, consequently we may safely deem this tree at Pasadena to be only a variation of the mahogony or binnak.

There is an old specimen in a garden on the northeast corner of Main and Sixth streets, Los Angeles. There are also a number planted as sidewalk trees on the corner of Ninth and Alvarado streets, Los Angeles. These latter demonstrate what an excellent street tree it can make. They are vigorous and shade the whole sidewalk. There is another fine specimen but with a double stem, in a Pasadena garden on Orange Grove avenue, near California street.

The rapid growth and great vigor of this tree recommend it for more extended planting than it has had. It is one of the largest trees in the Scharff collection. The

only reported drawback is a tendency to lose branches in heavy winds. Messrs. Scharff & Shorting speak of this as a weak point, but the vigor of the tree is so great that it does not show any such effects in its present appearance.

EUCALYPTUS GONIOCALYX.

Eucalyptus goniocalyx is known as the blue gum of New South Wales, where the Eucalyptus globulus does not grow. It is spoken of by Von Mueller as one of the best Eucalypti for forest planting. The wood is hard, tough, and difficult to split and also exceptionally durable, both in and out of the ground. It is one of the species of the genus that has a particular tendency to vary especially in its bark. In this respect it is sometimes of the Hemiphloiæ type and then called a box tree, and at other times of the Leiophloiæ, and then called a blue gum or white gum tree. We have very few of them in California, in fact I am certain of but one, that at the Forestry Station, Santa Monica. This specimen in its buds, flowers, fruits and foliage exactly corresponds to Von Mueller's plate. There are several other older trees in different places that come nearer to the botanic description of Eucalyptus goniocalyx than to anything else and yet vary sufficiently from them to suggest another species. Two of these trees are at Santa Monica Heights. Even these two vary from each other in the fruits, but not in a very marked way. At a casual glance these trees would be mistaken for Eucalyptus globulus, although, of course, not at all like that in flower or fruit. I have never seen a botanic description of Euca-

lyptus Maideni, called also a blue gum in New South Wales, and the Heights' trees may belong to that species. All of these trees are vigorous and thrifty and seem to be perfectly at home in our coast climate. They are, however, no more attractive in appearance than the blue gum, and Eucalyptus goniocalyx is not likely to have much of a vogue with us.

EUCALYPTUS PUNCTATA.

This tree is of a more spreading habit than is usual, especially as seen next to Eucalyptus globulus and Eucalyptus viminalis, in the Santa Monica Park, Nevada Avenue. The wood is tough and very durable, and of a pale reddish brown color. Its name of Leather Jacket comes from its tough rather dark colored bark, and its other vernacular name "Hickory" from the toughness of the timl er. A good many of these trees are scattered about Southern California. In a lot of 280 boxes of seedling Eucalyptus, raised by me and presented to the State Board of Forestry, there were, as nearly as I can recollect, about 50 boxes of Eucalyptus punctata. This number will represent what are growing in this part of the State.

The bark is darker than that of Eucalyptus rostrata and is apparently not so persistent. The leaf is very much like that of Eucalyptus resinifera, being dark green and glossy above and paler beneath. This tree is reported to prefer dry and rocky situations. Its foliage is one of those producing the melitose-manna most common in Eucalyptus viminalis. Our Eucalyptus punctata and Eucalyptus resini-

fera merge toward each other in some ways and produce a mind confusion. What we believe to be Eucalyptus punctata corresponds in every way to Von Mueller's plate and description except in having a straight instead of cork-screw style in the bud, while, on the other hand, Eucalyptus resinifera with a fibrous bark, always single umbels and not paniculate, and corresponding in the fruit and seeds to Von Mueller's account of resinifera, has with us a cork-screw style instead of a straight one in bud. In other words the style is exactly opposite to what we expected to find. The fruits in the resinifera here vary a good deal, as do also the shapes of the operculum or flower cap. Von Mueller speaks of Eucalyptus resinifera as having a vigorous capacity for varying.

EUCALYPTUS SALIGNA.

This tree is called a blue gum in New South Wales. Its appearance here thus far gives no reason for the name. The foliage is dark green and glossy above and paler beneath. The bark decorticates in small pieces leaving a rich reddish-brown stem mottled with olive green. The large branches are olive green. I mean the commercial olive green which is a color quite foreign to the olive. It is a handsome vigorous tree that grows well at the Santa Monica Station. The tree has just flowered at the Station and I believe for the first time. At any rate I have long watched for flowers without finding any. The buds, flowers, and immature fruit as at present found are very different from

the tree which we have identified as a sport or variety of Eucalyptus botryoides that has also a decorticating bark. The buds and fruit in Eucalyptus botryoides are markedly angular and more crowded together, and the bark of the one specimen that decorticate comes off in long strips. Eucalyptus saligna has a good reputation as a timber tree and has proved here a fast grower but is very shy in flowers or fruits at Santa Monica.

EUCALYPTUS TETRAPTERA.

This tree is a dwarf with very thick long scattered sickle-shaped leaves. The flowers are pendent, very large, solitary and quite numerous. The tube of the calyx is very angular, in fact winged. At Santa Monica the calyx tube and the stalk just before the cap falls become a brilliant crimson, and are by far the most striking part of the flower. The stamens are comparatively short and of a dark red, the anthers are purple.

EUCALYPTUS MINIATA.

I have elsewhere alluded to Eucalyptus miniata as shrubby. It, however, grows to be a tree of seventy or more feet in height. It has crimson flowers and often a silvery white bloom on the foliage. The leaves are somewhat paler beneath. It is a native of the tropical part of Australia. The tree has not, to my knowledge, been introduced here, but certainly deserves to be tried.

Mr. Walter Gill has furnished me a note on Eucalyptus hemiphloia, which it is too late to put in its proper place.

He states this tree to be native to the country about the head of Spencer's Gulf and on iron and sandstone ranges to an elevation of 3000 feet. In that section it is subjected to quite severe frosts. The tree is consequently one suited to situations trying on account of cold as well as drought. These points of advantage cause me to regret all the more our lack of success with the seeds of Eucalyptus hemiphloia. From what Prof. Maiden says about the N. S. W. hemiphloia, it seems probable that the South Australian form will prove at the least a variety.

UNIDENTIFIED TREES AT FORESTRY STATION.

There are at the Santa Monica Forestry Station a number of trees that have never flowered, some of these are labelled and some not. Amongst the most promising of these are the following:

Sewall's red gum. This tree grows well. It resembles Eucalyptus saligna.

Eucalyptus rudis. A good vigorous appearing tree.

Eucalyptus exima, dark green and unusually large leaves.

Neither Eucalyptus leptophleba nor the small gray-leaved Eucalyptus pinnata have grown well.

Since writing the above, Eucalyptus rudis has flowered at the station and I have found it in profuse bloom at Santa Monica Heights and on the extension of Figueroa Street, south of Los Angeles. The Heights specimen has the curious characteristic of alternating colored flowers. About one-third of the flowers are all pink and the rest all cream-white. These different colored flowers occur all over the tree. I know of one specimen of the blue gum, Euca-

lyptus globulus, that also has alternating pink and white flowers. This year about two-thirds of the flowers are pink and one-third the usual cream-white. One often sees imperfectly colored, or, as in the hydrangia, differently shaded flowers on the same base color, but two distinct colors such as madder-pink and cream-white solid in alternating blooms on the same branch, is something novel to my limited experience. This blue gum is on Third Street, Santa Monica, in the business quarter.

SPECIES AT UNIVERSITY, BERKELEY.

In a day's trip about Berkeley, I found fourteen species of Eucalypti, of these a very poor specimen of Eucalyptus redunca was the only one not known here. However, new sprouts from a number of eucalyptus trees, cut out in the grounds, show these to be probably species not known in California. It seems a pity that rare trees should have been chosen for the thinning process, instead of some of the excessive plantings of Monterey Cypress.

Back of a grand stand on the campus is the best specimen I know of Eucalyptus viminalis with persistent bark. It is a handsome tree, with flower buds larger and more nearly round than the smooth-barked decorticating variety. It is not so erect in growth. Along side of these dark rough-barked viminalis stands for convenient comparison a superb specimen of the white smooth-barked variety. These trees seem to me to have differences great enough to warrant specific rank in each case. The habit of growth in the two trees is not the same. The rough-barked one is irregular and spreading, while the smooth-barked one is

tall, erect and regular. The variations in the bark of eucalyptus trees, classified as belonging to the same species, has been attributed to diverse geologic or climatic conditions. At Berkeley we see the Eucalyptus viminalis on the same soil showing on the one hand a rough, dark persistent bark, and on the other a smooth, white decorticating one.

I was struck at Berkeley by the great number of Monterey Cypress seedlings coming up in the grounds. We see oaks, Eucalyptus and acacia seedlings often enough in California, but those of Cupressus macrocarpa are almost unknown except in a nursery.

The handsomest exotic trees I saw at Berkeley were, I believe, specimens of the black wattle, acacia decurrens. The feathery foliage in dense masses on these giant trees was both charming and impressive. The rich, heavy soils of Berkeley are evidently to this tree's liking. There are good specimens of the rough persistent and smooth decorticating barked varieties of Eucalyptus amygdalina on the Campus, otherwise the Eucalyptus plantations at the University grounds are uninteresting.

EUCALYPTUS FOR BEE FEED.

My attention was first called to the value of this genus to bee men by Prof. A. J. Cook, of Claremont. Many of the species are profuse bloomers and are rich in nectar. Besides this valuable characteristic, various of the species flower at seasons when there is a great scarcity of bee feed. In Southern California the different species of Eucalyptus vary in their times of blooming according to the soils and climates where they are located, and also according to the character of the seasons. Besides these sources of variability, individual trees often bloom earlier or later than the average of the same species. Taking the sixty species and marked varieties of this genus in Southern California, I have never seen a day that flowers could not be found on some of them. What the value of the Eucalyptus really is as a honey producer, and especially its value in individual species, is as yet undetermined. Several of the species are certainly important in this regard, sufficiently so to cause careful observations on all the species. When we consider the free production of nectar by the Eucalyptus at seasons when there is little or no other resource for bees, and also the claimed medicinal value of honey from Eucalyptus flowers for relieving irritation of the mucous membrane and as a nerve sedative, the presumption is strongly in its favor. Bee men will doubtless find it to their interest to study the species and plant in waste places such sorts as will furnish the best kinds of

nectar during the most difficult season for the bees. The following notes apply specially to Santa Monica:

From a bee point of view, the Eucalyptus may be divided into two classes—those that flower but once a year and those that flower more than once, or have a prolonged blooming season.

There are not many of the first type here. Eucalyptus polyanthema is one of the few that blooms but once in the year, as far as we have noticed. The variety of Eucalyptus sideroxylon (generally sold as Eucalyptus leucoxylon) with a lemon colored or white flower, is thus far a very shy bloomer and consequently of little value for bee feed. The pink flowered varieties, both with green or gray leaves, have a prolonged season of blooming and for the most part have two seasons, one commencing about the end of November and the other in May. Both the white and pink flowered smooth barked Eucalyptus leucoxylon follow about the same seasons, but while more profuse in the spring flowering, have this shorter than Eucalyptus sideroxylon. Bees frequent these flowers. The two principal varieties of Eucalyptus amygdalina here, viz., var. regnans and var. linearis or angostifolia are rarely out of bloom. The leaves of this species are very strong odored of a pepperminty-Eucalyptus smell, which, if it attaches to the flowers or nectar, might give a flavor to the honey that would lessen its value, or, on the other hand, insure the very fancy London price recently current for honey claimed to have been derived from Eucalyptus.

Eucalyptus corynocalyx, the sugar gum, is certainly a fine bee feed tree. Here it has two, and often three seasons; one of these commences in September or the end of August and continues through November. In the warm September

weather this year, 1895, the bees did a humming business over the sugar gum flowers all about Santa Monica. Eucalyptus siderophloia has also a flowering time in the same difficult months, but it has no such profusion of blossoms as the sugar gum nor is it so fast a grower. Eucalyptus longifolia has a prolonged spring blooming time. This tree is in full bloom now at Santa Monica, December, 1895. It is reported to be a good bee feed by Prof. Cook.

A crimson flowered variety, which seems to belong to Eucalyptus occidentalis or to Eucalyptus obcordata, (our variety Californica, or perhaps Hooker's Eucalyptus platypus) is practically a perennial and free bloomer. I have yet to see this tree without flowers since it first bloomed. Bees like it and frequent it. The typical Eucalyptus occidentalis, with creamy flowers, is quite a constant bloomer but nothing like this beautiful crimson flowered variety.

Eucalyptus occidentalis has two seasons; one commences in November. This is also the case with Eucalyptus diversicolor, Eucalyptus Lehmanni and Eucalyptus robusta. The latter is a very profuse bloomer, commencing one of its seasons in November, and I should think would be a good bee feed. Eucalyptus diversicolor flowers very freely in December and is popular with bees. Eucalyptus globulus commences a prolonged winter blooming in November. It is much sought by bees and must be an important source of honey in this county. The blue gum is a large tree and is profuse in its flowers. The size of the tree and the number of its flowers, together with the duration and seasons of blooming and the nectar contents, are all favorable to this gum.

Eucalyptus cornuta has two seasons of blooming, one in winter and one in July and August, the last ending

just about the time the sugar gum, Eucalyptus corynocalyx, begins. The flower of cornuta has a very long lid or cap as its name suggests. This cap, when it separates from the calyx tube, continues to half cover the stamens for some little time. The bees only seek these flowers while the cap still partially covers them and not when it is entirely off. This is also the case in the closely allied tree Eucalyptus Lehmanni, and to a greater or less extent in Eucalyptus siderophloia.

Eucalyptus citriodora, in winter, blooms quite freely in its white panicles but only once a year, so far as I know. The pronounced lemon scent and fragrant odor of the leaves of this species suggests the possibility of some such flavor existing in the nectar. Whether such a flavor is transferred by bees and recognizable in the honey is for practical bee men to say.

I believe that by some study of this subject species of Eucalyptus with plenty of nectar could be so selected as to give a constant crop of flowers or flowers at such times as these are absent in other plants.

Nearly all the species have their most luxuriant flowering time in the winter and early spring. Eucalyptus sideroxylon has its main flowering time in the late spring and early summer, then comes Eucalyptus cornuta in July and August, then Eucalyptus corynocalyx from September to November, and then Eucalyptus globulus and Eucalyptus robusta, connecting back by the rich and numerous flowers of Eucalyptus polyanthema.

I am of opinion that all the species that commence blooming in November and during the winter continue more or less generally their flowering well into the spring months.

The drawback to spring flowering Eucalyptus for honey is that the distinctive flavor is apt to be mixed with the flavor of the highly prized orange flower honey gathered at that season.

BARKS.

Many of the Eucalyptus trees under observation in Southern California are young, say seven to nine years of age. The bark in trees of such age is probably not a reliable indication of what the bark is in maturity. This source of error must be taken into consideration when studying our Eucalypti. Barks here are from a quarter to an inch and a quarter thick.

Eucalyptus globulus (old trees, 20 years) bark decorticates on lower main stem in small lengths and without leaving entirely smooth bark. It is rough, fibrous, thick on lower stem to about six feet above the ground. On the stem generally, and branches, the bark is shed in long stringers, leaving the new bark smooth. Outer bark light brown or greyish ; smooth bark when first exposed, buff turning to a light olive or blue-grey. Bark of saplings smooth, green, persistent. Twigs of young generally blue, sometimes crimson, of older trees, yellow.

Eucalyptus corynocalyx (10 years) general effect of persistent bark but it partly sheds in short patches. Main stem color a rich cream, of duller color just before decorticating. Branches are olive or bluish grey before shedding, creamy afterward; twigs red. Young trees shed bark in short curls, often till seventh or eighth year.

Eucalyptus calophylla bark of stem rough, fissured, persistent dull grey. On branches sheds in short patches leav-

ing new bark a light warm brown; twigs greenish grey or crimson or red. Some seven year trees have stem bark decorticating in flakes or blisters; outer bark grey, under bark buff.

Eucalyptus diversicolor (Santa Monica, 10 years) stem bark persistent, creamy grey, but does shed short pieces; smaller branches shed bark; general effect persistent, rough fissured at base; twigs green.

Eucalyptus cornuta (9 years). Bark at base rough, persistent, dark grey. Even surfaced and warmer colored above, greyish buff, general effect persistent, but sheds occasionally in thin small pieces in upper part. Bark on branches persistent, lavender grey; twigs red—very young, greenish yellow. Saplings shed bark in short curls very similar to young sugar gums. This bark shedding seems to persist longest in the least vigorous trees of such species as eventually have persistent bark.

Eucalyptus viminalis (8 to 10 years). Stem bark rough, persistent, light brownish grey, but does shed little shreds in upper part. Branch bark sheds, leaving under bark a smooth light grey; twigs red; very young, yellow green.

Second variety sheds in long streamers a light, tan-colored bark. Smooth bark, white or light buff, or blue-white—general effect smooth and white.

Eucalyptus rostrata (10 years). Stem bark even surface persistent, a rose grey or ash grey. Branch bark persistent, but often sheds small patches at junction with stem; twigs red—bright green when young. Young growth of sapling and seedlings, red.

The bark of Eucalyptus tereticornis is similar to that of rostrata, in fact these two species merge to each other so as to be difficult to definitely separate.

Eucalyptus longifolia (20 years). Bark rough, persistent, standing on stem in broken flakes which are to some extent shed, but do not appear to shed in sufficient quantity to change bark appearance. Bark of young trees not so rough or flaky.

Eucalyptus punctata (20 years). General effect of persistent even-surfaced granular rough bark of rose grey color. Sheds in upper stem and branches. New bark bright tan and smooth. Some specimens of this tree shed bark only on the smaller branches.

Eucalyptus citriodora (9 years). Smooth from decortication; outer bark pink grey; new bark smooth white or pinkish white. General effect smooth and white; twigs red.

Eucalyptus eugenioides (9 years). Bark rough, soft, thick and sometimes has effect of being crossed or woven. Small branches shed dark grey bark in curls leaving new bark tan color and smooth. Stem bark grey with tan color showing in the numerous fissures; twigs grey or red.

Eucalyptus amygdalina, var. angustifolia (9 years). Bark even surfaced, persistent; or decorticates, in most of these trees leaving bark smooth, of olive-tinted white. Two 20-year old specimens; both shed bark.

Var. linearis—(bluish leaves). Bark smooth, decorticates. Old bark slate-colored, new bark, white—white bloom on twigs.

Var. regnans—Bark even surfaced, but somewhat rough, grey, persistent; smooth decorticating on young branches; twigs yellow or green, on old ones reddish.

Var. bush.—Bark grey persistent, even surfaced, rather smooth.

Var.—Large fruited; narrow leaved; twigs red; bark, slate colored and decorticates, leaving smooth white bark.

Var.—Very narrow thick leaf; strong small tree; bark on stem sheds; leaving new bark smooth white.

The varieties of Eucalypytus amygdalina, angustifolia and linearis are named for convenience, but their botanic descriptions are too meagre to be relied on.

Eucalyptus Gunnii (9 years). Bark persistent close to base, otherwise sheds in short brown pieces. New bark smooth white.

Eucalyptus Planchoniana (9 years). Bark sheds, smooth bluish grey.

Eucalyptus polyanthema. Surface even, flakey rough, persistent, or perhaps shedding slowly in small pieces, and without general effect. Branches smooth, spotted from decortication.

Eucalyptus macrorrhyncha (9 years). Rough, brown, fibrous, persistent.

Eucalyptus Stuartiana (9 years). Bark brown, persistent and rough on stem; smooth or decorticated on branches, blue bloom on twigs.

Eucalyptus melliodora (9 years). Bark even surfaced, somewhat rough, persistent, warm tan grey; branches shed, leaving mottled appearance.

Eucalyptus gomphocephala (9 years). Bark dark grey, even surfaced, rough, persistent. 20-year specimen bark very dark colored. Branchlets decorticate leaving new bark smooth and white. Twigs reddish yellow.

Eucalyptus Lehmanni (9 years). Bark shed in small curly pieces; new bark, smooth brown.

Eucalyptus rudis. Bark smooth, mottled from decortication; twigs red.

Eucalyptus occidentalis. Bark on stem grey, rough, flakey, mostly persistent. Branches smooth, light buff from

decortication; twigs red, or very young, greenish yellow.

Var. Californicus. Bark sheds in short flakes leaving new bark smooth buff; outer color, rose grey; twigs and branchlets green, only grey or brownish just before shedding. Yellow flowering variety has green twigs but red old branchlets.

Eucalyptus obcordata. Same, except branchlets dark red before decorticating, and only extreme new growth green.

Eucalyptus sideroxylon, bark red, often very dark, fissured, rough, persistent.

Branches in marked contrast, bluish grey, smooth, and shed bark.

Eucalyptus leucoxylon, bark smooth from decortication, color blueish-white or very light buff. Twigs reddish, new growth green.

Eucalyptus robusta, bark rough, brownish or grey, persistent; twigs red.

Eucalyptus pauciflora, bark smooth, white from decortication.

Eucalyptus siderophloia, bark rough, persistent, brownish grey. Branches smooth decorticating; twigs red.

Eucalyptus obliqua, bark rough, persistent, brown; twigs dark red.

Eucalyptus botryoides (20 years), bark on main stem, rough, persistent, dark grey, decorticates on branches, outer bark, then tan colored, inner or new bark smooth, shaded, sometimes olive or warm buff color. One specimen at Scharffs sheds bark on main stem. This stem has appearance of other botryoides branches. The twigs on the persistent bark specimens are green, while on the decorticating one these are wine red.

Eucalyptus saligna sheds bark, and looks like decorticating botryoides. These two species are difficult to separate when Eucalyptus botryoides decorticates throughout. Eucalyptus botryoides has hemi-ellipsoid, angular fruits, almost or entirely without stalklets. Eucalyptus saligna has bell-shaped or semi-ovate fruit, not angular, and here at least, the stalklet is quite distinct. Twigs in Eucalyptus saligna green. If the twig colors are a persistent characteristic, the decorticating botryoides must be a variety whose red twig color would easily distinguish it from saligna.

Baron Von Mueller at one time suggested a classification of the Eucalyptus on their cortical systems. His divisions were as follows:

Leiophloiæ, bark smooth from decorticating, as in Eucalyptus globulus; or persistent even surfaced, as in Eucalyptus rostrata.

Rhytiphloiæ, rough or even surfaced bark, with main stem not decorticating, Eucalyptus resinifera, Eucalyptus cornuta, Eucalyptus robusta.

Inophloiæ, bark rough, persistent on stem. Eucalyptus Stuartiana, Eucalyptus eugenioides.

Lepidophloiæ, persistent bark on stem, laminated, friable, easily separated. Eucalyptus miniata, Eucalyptus phœnicia.

Pachyphloiæ, as in Eucalyptus ptychocarpa. This tree has a grey, wrinkled, everywhere persistent, somewhat fibrous bark.

Schizophloiæ, bark rough, persistent, as in Eucalyptus calophylla, Eucalyptus sideroxylon.

I have not seen an account of Baron Von Mueller's system, but judge from his notes on Eucalyptus trees that the classification was made on a microscopic study of the

barks. The superficial appearance of the barks of the trees does not command a ready assent to Von Mueller's cortical arrangement of them. The bark of Eucalyptus robusta or Eucalyptus corymbosa is, in looks, not at all like that of Eucalyptus cornuta, but these are classed together in the Rhytiphloiæ. Nor is the bark of Eucalyptus rostrata outwardly even suggestive of that of Eucalyptus globulus, though these two stand cortically together in Leiophloiæ.

Prof. Maiden writes me from Sydney that he considers the cortical classification the best for field use.

In 100 parts of fresh Bark.	Kino-tannic Acid.	Water.
Eucalyptus Leucoxylon (rough-barked) our sideroxylon	21.94	51.13
globulus	4.84	51.54
rostrata	8.22	51.16
Gunnii	3.44	54.09
polyanthema	3.97	46.66
melliodora	4.03	54.94
obliqua	2.50	36.81
obliqua	4.19	51.59
amygdalina (rough-barked)	3.40	43.25
amygdalina (rough-barked)	3 22	39.63
goniocalyx	4.62	51.00
goniocalyx	4.12	45.50
macrorrhyncha	11.12	35.91
macrorrhyncha	13.31	39.56
viminalis (smooth-bark)	4.88	52.88
viminalis (rough-bark)	5.03	54.10
viminalis (young-tree)	5.97	55.03

Table from F. v. MUELLER.

SANITARY.

To the planting of Eucalyptus trees in malarial districts has been very generally attributed an ameliorating effect upon human health. This is a question of so much interest and importance that it deserves special consideration.

Malarial fevers have a wide range in the climatic belts adapted to one or another of the Eucalypti. These fevers prevail usually in low or marshy places, where the soil water is not far from the surface, and where there is a prolonged period in the year when the temperature stands constantly above 62° F. Some upland valleys also suffer severly from disorders due to malarial poison. A slight elevation in a malarial country is often more dangerous than the lowest places.

The malarial germ is doubtless introduced into the human organism both by water and by air. It is probable that foods, such as milk, may also serve as vehicles of introduction.

All forms of malaria are endemic or purely local diseases.

The only exceptions to this are of children born to a parent suffering with malaria, at the time of fecundation of the egg.

A number of Scotch cases are on record of inherited malarial trouble, in all of them from the father. In this respect malaria resembles the dreadful inheritances of syphilis.—(*Medical Record*, *N. Y.*, Fournier, Paris.)

The evidence seems fairly conclusive that the ordinary American types of malaria are most frequently occasioned in humanity by the drinking of unboiled water from shallow wells.

I have a great number of instances that go to show this to be the case.

C. Buhman of Los Angeles, formerly a resident of Galesburg, Illinois, tells me that the boiling of the drinking water in that place which he states to have become general at one time, did not eradicate malarial fevers but did so much diminish these fevers in the population both as to numbers attacked and the intensity in those who were still affected that he and others attributed the improvement to boiling the drinking water.

At Bakersfield, Central California, there prevailed formerly a specially malignant form of malarial fever. It was sometimes called dengue but more generally "Bakersfield fever." At that time the drinking water all came from shallow wells.

While the district in and about Bakersfield has received a great accession of population the people now have a healthy look very different from the old appearance and the malignant fever so well known to old timers is no longer heard of. The drinking water now comes from deep artesian wells.

The turning up of earth produces in malarial districts an access of disease which I think must be attributed to air infection.

Dr. J. J. Salisbury of Cleveland, Ohio, made a careful series of experiments on the saliva of numerous residents in a malarial district.

Amongst the other forms of bacterial life in the saliva

was always found certain algoids resembling the palmellae. Similar examination of saliva of residents of non-malarious districts showed none of this particular form of bacteria. Dr. Salisbury's researches were carefully made and the microscopical work well checked.

His conclusions were that malarial fever was produced by spores of bacteria that rose only a definite distance from the soil level in infected districts, and that these were never present in the air during the day. Dr. Salisbury's work was done in his course of instruction at the medical school of Cleveland. These researches attracted more attention abroad than at home. The work was translated into French and first published in the Revue des Cours Scientifiques of November 6, 1869.

The saliva of all those examined in the malarial district contained the special form of bacteria to which he attributed the disease. If his conclusions and the later ones of Crudeli are correct, and those also of the water infectionists, we must say that malaria comes from both causes.

In 1881 Dr. Alphonse Laveran discovered the plasmodium of malaria, which he named "*oscillaria malariæ*." His description is considered more correct than that of Klebs and Crudeli.

I present the following conclusions on malaria:

First—That malarial disease is primarily due to a bacillus of certain type.

Second—That such bacilli germs are found in the soil, air and water of malarial districts.

Third—That neither water alone, air alone, or soil alone, will support the life history of the malarial bacillus.

Fourth—That the germ of malaria may be carried in earth, air or water.

Fifth—That the development of malarial bacteria in sufficient quantities to attack and overcome the resistance of human beings can only take place in localities without complete natural or artificial drainage, where the sub-surface water remains stagnant and where the temperature for a prolonged period remains constantly above 62° F.

Individuals vary as to their susceptibility of infection.

First—As to method of introduction of infection.

Second—As to individual resistance.

Third—As to condition of individual during exposure.

Salisbury's work points to the air as the main source of infection. The spread of malarial disease to leaward of regularly affected localities and the wide spread dread of night air in all the old malaria-cursed districts of the world point in the same direction.

Senator Tommasi Crudeli, the distinguished collaborator of Klebs, takes a similar view in his studies of Italian malaria. R. Carlotti speaks of wind-carried malaria in Corsica.

Malarial disease has been diminished by quinine, by drainage, by permanent flooding in the hot season (Egypt), by gates on seacoast lagoons which close with the rising tide and open for the exit of fresh water at low tide (coast of Tuscany), and it is claimed by planting certain species of Eucalyptus, especially Eucalyptus globulus and Eucalyptus amygdalina.

As far as I can learn the first published investigation of the prophilactic and therapeutic value of the Eucalyptus was by M. Tristani, a Spanish physician in the Compilador Medico, 1865.

It is in Spain that we still find the greatest belief in the medicinal value of the Eucalyptus. In that country

the people have gone beyond reason ; indeed they may be said to regard the healing power of the Eucalyptus with the confidence of superstition.

In Cordova the young Eucalyptus trees were stripped of their leaves and it was impossible to keep them alive until guards, to prevent this leaf stripping, were appointed.

From Cordova the Eucalyptus craze spread through other Spanish towns, traces of which are to be found in their municipal regulations, such, for instance, as the one prohibiting the picking of Eucalyptus leaves without an official permit issued only on evidence of the medical need of applicant.

Travellers had long before noted the use of poultices of Eucalyptus leaves of different species by the natives of Australia for wounds, but without attracting attention to the application of such remedy to the Aryan.

One case is of record of a native Australian so severely wounded in the abdomen that the intestines protruded and had to be pushed back, who was treated by a poultice of Eucalyptus leaves and recovered without even severe inflammation.

I have observed in our western plains the use of tobacco on severe wounds by guides and trappers with a similar result of preventing pus and promoting the prompt healing of wounds.

There is a disposition to ridicule what are called "old woman remedies,"—that is, the application by teas, poultices, etc., from the fresh leaves, roots, etc., of plants for healing hurt humanity. The term "old woman" came to be applied because in the early scarcity of physicians in America the duty of care in sickness fell upon the most experienced women, whose energies at that time were cen-

tered in the home. For my part I think that these old fashioned ways of using nature's remedies are too much neglected. If there is any laugh on such a question it would round itself out much better in the confusion of drug quality in a regular drug store than in the fresh infusion from the leaves of a medicinal plant picked when needed or in the various poultices, etc., of the now nearly extinct medically competent housewife.

There have been various examinations of drugs taken from different drug stores. The extraordinary variations in both the strength and quality of drugs thus shown are enough to seriously shake our confidence in the use of any drugs. New York State drug examinations have made expositions of drugs too strong, drugs too weak, and drugs entirely devoid of qualities for which they are used. This point is noted because where the Eucalyptus will grow the leaves can be had at any time. Their use for a tea and especially in external application, as in poultices, or in fumes when burning or steamed, can be had in all the force of freshness.

One of the great advantages of the Eucalyptus medicinally is its soothing quality and non-irritant effect, especially on the kidneys. It is in this respect very different from the product of the pine, the camphor tree, etc. This characteristic gives Eucalyptus preparations great value in the cure of troubles of the mucous membrane of the stomach, bladder and urethra. An appendix gives the official status of the Eucalyptus in medicine.

The principal claim for medicinal virtue in the Eucalyptus has been prophylactic. The Eucalyptus tree's power of preventing disease has not, I believe, been claimed to go beyond those forms due to malaria. It gained such a rep-

utation for preventing all forms of malaria that one of its species, the Eucalyptus globulus, was widely known as the "fever tree." The facts in regard to this matter are not in a reliable condition. We may put what we know in condensed form as follows:

Malaria is either mild or absent in Central and Southern Australia and in Tasmania.

Malaria seems entirely absent in the native haunts of Eucalyptus globulus, Eucalyptus urnigera, Eucalyptus coccifera, Eucalyptus amygdalina, Eucalyptus diversicolor, Eucalyptus calophylla, Eucalyptus leucoxylon, and other less important species.

This point is not reliably ascertained, but it is approximately as stated. Its value is not as great as might appear.

There is about the same absence of malaria in New Zealand where the Eucalyptus has no native representative. The disease is absent in the Scotch heathered hills, in the red wood districts of California, in the pine, cedar and sequoia forests of the Sierra Nevada, in the pine and spruce forests of the Sierra Madre of Los Angeles, and in the chapparral of the coast counties of California. Southern California has practically no malaria—a happy exemption that might be attributed in one place to various artemisia, in another to greasewood, in another to the giant Mojave cactus, and perhaps most agreeably to the red live oak. The cause of our Coast California general exemption from malaria must be due mainly to the fact that the nights are too cool for the life history of the malarial bacillus. A similar temperature inhibition exists in Tasmania and in the mountains of Australia. There are surely enough undrained, swampy and sour lands here, known locally as

"cienegas," to produce malaria if something else essential for its life were not absent.

In Queensland and generally in the tropical parts of Australia malarial fevers are quite prevalent and so, also, are largely represented considerable numbers of species of Eucalyptus; not, however, those named.

Those species of Eucalyptus found in Queensland are in an appendix. It is by no means certain that malaria is found where each of these species grow. It is, however, absolutely certain that various species of Eucalyptus and malignant malaria can exist together.

The Eucalypti that have been at all popular in California that are native to Queensland and North Australia are Eucalyptus pilularis, Eucalyptus sideroxylon, Eucalyptus hemiphloia, Eucalyptus siderophloia, Eucalyptus maculata, Eucalyptus rostrata, Eucalyptus tereticornis, Eucalyptus resinefera and Eucalyptus robusta. There are others like Eucalyptus corymbosa, Eucalyptus paniculata, Eucalyptus crebra, Eucalyptus hæmastoma, etc., which may prove valuable to us when better known.

The Eucalypti have been extensively planted in Corsica, Italy, Algiers, India, the South of France, Spain, California and in a smaller way in England and its outlying islands, in the Argentine, Mauritius, Zanzibar, Cuba, Spain, Cape Colony, and by the Russians east of the Caspian Sea. In Corsica, Italy, and in Algiers the planting of Eucalyptus, mainly Eucalyptus globulus, has been generally followed by or happened with marked improvement in the local health, especially as to malaria.

I have not been able to check up the conditions before and after the Eucalyptus planting. Nearly every case of Eucalyptus planting and better health was accompanied by

other works conducive to better sanitary conditions. Drainage works, intensive cultivation, better human quarters, better drinking water, etc., etc.

In Southern California we have no endemic malarial disease, unless there be mild forms in far interior points where the nights for sufficiently long periods are warm enough. We have consequently been unable to look over the local field for the effects of Eucalyptus trees on malaria. In Central California, however, it is claimed that plantations of Eucalyptus globulus have diminished or stopped malaria. Delano has been cited as a striking instance of this. We know that a number of species, notably the fast growing ones, have a drainage power in themselves. This power is well recognized here and results in the planting of Eucalyptus trees about cesspools and their being cut down along orchard lines from which they draw the moisture. Cesspools that overflowed and caused uneasiness and care have been kept down or dry by Eucalyptus trees. This is one way in which this tree might ameliorate malarial conditions.

Another is by its essential oil contained in quantity in the foliage of many of the species; these leaves contain an oil, etc., that is, in concentrated form, fatal to all insect and bacterial life. It occurred to me that the constantly falling leaves from species highly charged with Eucalyptus oil might disinfect the ground and ground water about them. I have found but little encouragement for such an opinion in my rather superficial experiments.

Prof. A. J. McClatchie kindly examined several jars of water into which leaves of Eucalyptus globulus were placed at the Throop Polytechnic Institute. Ordinary bacteria were found by him in great quantity in the jars at

the usual period, about as they would have occured had the leaves been from other trees. There was this exceptional fact, the odor of leaf decay was entirely absent. I tried four jars with one-half pound meat in each of them.

First jar contained meat alone.

Second jar contained meat and Eucalyptus leaves.

Third jar contained water and meat alone.

Fourth jar contained water, meat and Eucalyptus leaves.

The leaves were of Eucalyptus globulus. The experiment commenced on March 13th, 1895. The temperature, where the jars were, did not go above 80° until May, when it remained for some time with a daily maximum above that and for several days even above 90°. In other words, we had in May the desert influence for several days and an unusual heat such as for a few days we are liable to at nearly every part of the year.

March 17. Water jar meat without Eucalyptus spoiled.

" 19. This jar very bad.

" 19. Dry meat without Eucalyptus spoiled; fungoid growth on this meat not seen in dry jar with Eucalyptus.

" 26. Jar with meat and Eucalyptus leaves dry, spoiled.

" 26. Spilled water accidentally out of jar with meat, water and Eucalyptus leaves. Meat all right; smelt very strong of Eucalyptus. Put back same meat with fresh Eucalyptus leaves and fresh water.

May 10. First sign by oder of meat decay in this jar.

" 12. Did not seem to increase, but odor distinctly bad. Threw it away.

This experiment indicates that Eucalyptus globulus

leaves retard decay and are especially unfavorable to certain bacterial growths when soaked in still water.

Thus Eucalyptus globulus leaves in stagnant swampy places would probably diminish the vitality, if not destroy the bacteria of meat decay. What effect they would have on malarial bacteria is not indicated.

The jars were all left open and stood together in a large cool closet.

The Eucalyptus globulus leaves are largely used here in clothes as we used to employ camphor against moths.

One of the large clothing houses in Los Angeles uses the young blue gum leaves in place of the very disagreeable tar generally employed against moths with success. The great advantage to the house, as Mr. Wiener says, is in avoiding the very annoying smell of the tar preparation.

I use the Eucalyptus globulus leaves successfully against moths by hanging branches in the clothes closets and placing leaves amongst the clothes but it is not a complete guarantee against moths. It is said that this foliage will drive off mosquitos. I do not know how this is, but have seen standing water within fifty feet of Eucalyptus trees produce a few dull mosquitos, in a semi-occasional way. I have also seen the liveliest mosquitos and most savage stingers of California in the Eucalyptus groves along the Santa Barbara Coast. On the other hand at Nice, France, the annual tree trimming is followed by the natives to possess themselves of branches to hang in their houses. The object is both sanitary and anti-insect.

Camphor, oil of lavender, 1 pint to 5 of water, and kerosene oil, are used here against insects with a success that apparently varies with the individual experimenter. The common pyretherium is fatal to insects in powder

or in fumes from burning. I have, in central Egypt, killed the flies in a large room every night to prevent their early morning buzzing. I did this by closing it after sunset and burning pyretherium. The room was then reopened to get rid of the smell. Every fly was killed. Still, here in California, I have repeatedly failed to kill insects with this powder. On examining the powder, or rather having it examined for me, I discovered that it was adulterated, and, in several samples, contained no pyretherium whatever.

Differing results by experimenters with other agents may be due to a similar cause.

We use tobacco infusion against scale insects successfully, and could probably use one made from Eucalyptus leaves with equal effect.

I have a rain water cistern at my house which receives its supply from a roof on which Eucalyptus leaves are constantly falling, thence being washed into the cistern. From this cause the rain water has a slight amber tint and a scarcely perceptible Eucalyptus odor. This water never has had the disagreeable smell that occurs usually in rain water shortly after it is stored, and which afterwards disappears.

We have here a long dry season during which the water in the cistern would have ample opportunities to go through what is called in Louisiana "curing."

This curing I presume is really a process of fermentation of matter carried down with the precipitated rain water from the air.

I know no other rain water tank here, so that I am unable to learn in the same air conditions what would happen to rain water without Eucalyptus leaves.

I have tried a smudge of Eucalyptus leaves, meaning always Blue gum, on flies that came into my house in great numbers during the hauling of barn-yard manure in one of my orchards.

The smudge was made in a room 20 x 20 with French windows. The large chimney and loose window fitting made it anything but air-tight.

The flies from being aggressive, all collected on the windows as though they would have escaped if possible, and became very sluggish. A few died.

Some other leaf smudge would doubtless have done as much. I can recollect making grass smudges in the Wyoming Sloughs in banked up tents to kill the mosquitoes so that we could sleep. This process was exceedingly disagreeable while going on but a great comfort to the sleepers in that extraordinary mosquito haven. The great question then was which was worst, the day or the night mosquitoes.

During my residence in Egypt I followed the custom of the country and had during the day an attendant who constantly swished the flies away with a long switch of split reeds.

The wire screen is a means of keeping flies and also light and free circulation of air out of a house.

But these, as one of our literary lights says, are all other stories.

The claimed effect of Eucalyptus trees on bacterial life can be gathered by the instances mentioned below.

While these instances do not conclusively show any effect upon malaria by Eucalyptus trees, they do show by the general improvement in health where these trees succeeded that there is nothing in them against health.

The Spanish prejudice or superstition in favor of the tree has its counterpart in the regrettable crusade against the Pride of India, a tree that once shaded nearly all of Charleston's streets in South Carolina.

Some one started the idea during an epidemic of yellow fever that these trees were the breeders of infectious diseases and especially of yellow fever. The idea spread like the infection itself and swept the beautiful shade trees before it.

As the Pride of In lia had absolutely nothing to do with producing yellow fever in Charleston so it may be that the Eucalyptus has really done nothing against malaria.

INSTANCES OF IMPROVED HEALTH ATTRIBUTED TO EUCALYPTUS PLANTING.

M. Regulus Carlotti, the distinguished Corsican forester, has collected in his monograph entitled "Assainessement des Regions Chaudes Insalubres" a large number of instances of increased salubrity attributed to the planting of Eucalyptus. Amongst these he cites Chiavari on the east coast of Corsica. This is a penal station situated on the edge of the East Corsican plain that is so unhealthy that it is in summer practically uninhabitable. At Chiavari in 1855 (the date I believe of its establishment) they lost 65 of each 100 prisoners by death. This frightful mortality is sufficient proof of its sanitary condition. The works undertaken at this place comprised intensive culture, drainage works and the planting of Eucalyptus globulus. M. Carlotti reports the death rate at present to be normal. Drainage

works seem to have accompanied the planting of Eucalyptus in the cases where the best authenticated sanitary improvement occurred. M. Lambert, an Algerian forest officer, states that in the Forest of St. Ferdinand he had a station so unhealthy that it was uninhabitable. After the growth of a plantation of Eucalyptus set out at that point the fevers disappeared and an agent, already suffering from malaria moved to this station, entirely recovered.

Besides these M. Carlotti cites the great improvement at the Maison-Carrée in Algiers and in the Commune of Columb in the Republic of Columbia in South America, due to extensive Eucalyptus planting.

M. Gimbert, in a communication to the Academy of Sciences, takes strong ground in favor of the sanitary value of Eucalyptus plantations. Amongst the places cited by him to establish his point are the environs of Constantine Algiers, the Cape of Good Hope Colony, and in the French Departement du Var.

In No. 168 of our Consular Reports, obtained at my request, there are a number of valuable reports on this question.

All of these many experiments of Eucalyptus planting for health improvement, are favorably spoken of except in the report of Prof. Tommasi-Crudeli. This distinguished scientific man does not think that Eucalyptus planting will entirely prevent malaria. He examined the locations in Italy where benefits from this source were claimed, and shows that malaria has recurred in some of them, and that drainage works had been carried out in these places as well as Eucalyptus tree planting. A controversy has sprung up on this question, especially as to the ects of Eucalyptus planting at Tre Fontane in the

Roman campagna. The last word on this subject that I have seen is a pamphlet defending the anti-malarial value of the Eucalyptus at that monastery by Father Franchino.

EUCALYPTUS ON THE ROMAN CAMPAGNA.

Questions on the sanitary effects of the Eucalyptus plantations made at the abbey of the Tre Fontane on the Roman Campagna, answered by the abbey authorities. October 4th, 1895, obtained through the courtesy of the Countess Constance Gianotti.

1. What species of Eucalyptus have been planted?

Ans. Eucalyptus globulus, Eucalyptus resinifera, Eucalyptus rostrata, Eucalyptus viminalis, Iron-Bark, Eucalyptus Gunnii, Eucalyptus tereticornis, Eucalyptus Stuartiana, Eucalyptus uringera, Eucalyptus populifolia, Eucalyptus polyananthema, Eucalyptus goniocalyx and others.

(The Iron Bark is probably Eucalyptus sideroxylon. K.)

2. What is the area of Eucalyptus plantations?

Ans. 50 hectares (about 125 acres. K.)

3. What was the sanitary condition before plantations were made?

Ans. Bad.

4. What has been the sanitary condition since Eucalyptus plantations?

Ans. Better, quite supportable.

5. What other works of health improvement have been undertaken?

Ans. Making ditches.

EUCALYPTUS MEDICINALLY.

Preparations of Eucalyptus are used here quite extensively and the demand is rapidly increasing. The standing of Eucalyptus as a curative agent is higher amongst the laity than it is amongst the doctors. Teas and poultices made from Eucalyptus leaves are quite popular in California for colds and grippe. Leaves are also steamed for this purpose. A few drops of Eucalyptus oil in a hot bath is agreeable and reputed to be a nerve sedative. This treatment reduces the size of engorged spleens and is a palliative or cure in malaria. Preparations from the leaves are used in candy, for colds, in amycose as a hair restorer, in cigarettes for catarrh and in lozenges for the throat, hoarseness, etc. The most agreeable of these lozenges that I have tried are the "Mission Lozenges," made in Riverside, Cal. These have a good reputation amongst singers and speakers. All these preparations are from the leaves of Eucalyptus globulus. All our California Eucalyptus oil is from the same species. This unity of the source of supply has the great advantage of giving a reliable percentage of Eucalyptol, to which, principally, the curative effects are attributed. The Eucalyptus species vary greatly in the proportion of Eucalyptol that their oils carry. In some there is no Eucalyptol, this principle being replaced in some cases by Phellandrene. The Australian oils are from mixed species and to a considerable extent from Eucalyptus amygdalina leaves. This species, by the most recent analysis contains no Eucalyptol. It seems unfortunate that this large oil yielder

contains only Phellandrene. This principle appears to have curative properties similar to those of Eucalyptol and may be quite as effective. The chemical formulas of these two principles are.

Eucalyptol. C^{10} H^{16} O.

Phellandrene, C^{10} H^{16}.

Eucalyptus globulus oil contains about 60 per cent of Eucalyptol. The purchase of this oil is much the cheapest way to obtain Eucalyptol.

The Australian producers, Messrs. Sanders & Sons and Messrs. J. Bosisto & Co., have quarreled a great deal over the value of different species of Eucalyptus as sources of oil. Merk's "Eucalyptol," made in Darmstadt, is deemed reliable. While reliable supplies of oil from the leaves of Eucalyptus globulus are in the market, it is unnecessary to go to the expense of purchasing Eucalyptol. Eucalyptus preparations are claimed to be soothing and curative to the mucous membrane in the stomach, bladder and urethra, as well as to that in the nose and throat.

Listerine is a valuable and standard medium of the antiseptic use of Eucalyptus oil.

Eucalyptus lozenges made of the kino of Eucalyptus rostrata are prepared by Messrs. Wyeth Bros., Philadelphia. These are strongly astringent.

Euclyptus oil sprayed once or twice a day in a sick room takes off the stuffy or sick room smell and has the effect of making the air feel brighter and more stimulating. When to these good qualities we add the authenticated antiseptic effects of Eucalyptus oil, we may well be surprised that it or some similar agent is not universally used in sick rooms, hospitals and maternity wards. The spray is used in diphtheria.

(From Pharmacology of the Materia Medica.)

EUCALYPTUS GLOBULUS, Sabil.

Synonyms.—Australian Gum Tree, Blue Gum Tree, Fever Tree, Iron Bark, Woolly Butt.

(Iron Bark and Woolly Butt are not synonyms of Eucalyptus globulus.—Ed.)

Part Employed.—The leaves.

Natural Order.—Myrtaceæ.

Habitat.—Australia.

Properties.—Stimulant, aphrdoisiac, antispasmodic and eminently antiseptic in its action ; recommended in the treatment of intermittents, especially in those chronic varieties in which quinine has failed; also in septic fevers, diphtheria, etc. As an antispasmodic it is useful in asthma, but its chief uses depend upon its antiseptic character. Thus it is employed in the treatment of fœtid breath, ulcers (syphilitic and otherwise), purulent catarrhal affections of the bladder, urethra and vagina, spongy and bleeding gums, etc.; externally, suitably diluted, the fruit extract is employed also as a disinfectant lotion in gangrenous or fœtid suppuration, foul ulcers and offensive discharges of the skin.

Preparations.—Eucalyptus Oil; dose, 5 to 30 minims (0.3 to 2 C. c.).

Capsules, Oil Eucalyptus, in soft gelatin; Oil Eucalyptus, true, 5 minims; Oil Sweet Almond, 5 minims; also in hard gelatin, substituting olive for the almond oil; a favorite method of Prof. H. C. Wood of exhibiting this remedy as a stimulating expectorant; he recommends that it be given 4 times daily in 10-minim doses.

Fluid Extract Eucalyptus, U. S. P.; not miscible with water; dose, 15 to 60 minims (1 to 4 C. c.).

Powdered Extract Eucalyptus; of the same strength as the solid extract, prepared by evaporating, at a low temperature, the solid extract, and replacing the moisture with powdered Eucalyptus leaves; dose, 3 to 10 grains (0.2 to 0.65 Gm.).

Solid Extract Eucalyptus; one part equals 5 leaves; dose, 3 to 10 grains (0.2 to 0.65 Gm.).

Elixir Eucalyptus Compound ; each fluid ounce represents ingredients specified; Eucalyptus Globulus, 15 grs.; Wild Cherry, 16 grs.; Gentian, 4 grs.; Licorice, 15 grs.; Dandelion, 20 grs.; Syr. Yerba Santa Arom., 30 minims.

Inhalant, Eucalyptus, No. 7 of P., D. & Co.'s series of inhalants; Oil Eucalyptus, 1 fluidrachm; Inhalant No. 1 (neutral oil), 1 fluidounce; used with advantage in fœtid brochitis, diphtheria, etc.

Lozenges, Eucalyptus, containing: Ext. Eucalyptus, true, 3 grs.; Ext. Licorice, 1 gr.

Pills, Eucalyptus Compound, 1 5-8 gr.; Ext. Eucalyptus, 1 gr.; Ext. Canadian Hemp, ½ gr.; Sanguinarin, 1-8 gr.

Pills, Eucalyptus Extract, 2 grs.

Pills, Fever and Ague, 2 grs.; Ext. Eucalyptus, ¼ gr.; Chinoidin, 1 gr.; Iron Ferrocyanide, ½ gr.; Powd. Capsicum, ¼ gr.; Arsenious acid, 1-200 gr.

THE CHEMISTRY OF EUCALYPTUS.

Hartzer* (1870) obtained from the leaves tannin, cerylic or an allied alcohol, a crystallizable fatty acid—the sodium salt of which is soluble in ether—and three resins, one of which has acid properties, and yields with sulphuric acid a carmine-colored copulated acid, becoming violet with ether.

E. S. Wayne† (1870) likewise isolated an acid resin, which he found to be crystalizable, and to give a brown-red reaction with ferric chloride. The most important constituent, however, is the volatile oil, of which the leaves yield about 6 per cent.

The United States Pharmacopœia recognizes the oil obtained from *Eucalyptus globulus*, *Eucalyptus amagdalina* and some other species of Eucalyptus.‡

These volatile oils are colorless or pale yellow, thin liquids, becoming thicker and somewhat darker by age. They are neutral to test-paper, are highly and more or less pungently aromatic in odor and taste, that of *Eucalyptus globulus* being camphoraceous, that of *Eucalyplus amygdalina* somewhat resembling peppermint, while others have a more terebinthinate or lemon-like odor, and that of *Eucalyptus persicifolia*, or peach gum, like oil of bitter almonds, with which it agrees in containing hydrocyanic acid. The specific gravity of these oils varies between .88 and .94, and their boiling points between about 130° and 200° C. (266° and 392° F.)

The dextrogyre oil of Eucalyptus globulus was examined by Cloëz (1870) and by Faust and Homeyer (1874). Cloëz regarded the oil as being chiefly composed of Eucalyptol, $C^{12}H^{20}O$, boiling at 178° C. (352 4° F.) and yielding with phosphoric anhydride two compounds, $C^{12}H^{18}$, of

* American Journal of Pharmacy, 1876, p. 329.
† American Journal of Pharmacy, 1876, p. 23.
‡ This error I have referred to, Eucalyptus gobulus oil containing eucalyptol and Eucalyptus amygdalina, Phellandrene.

which Eucalyptene boils at 165° C. (320° F.), and Eucalyptolene at about 300° C. (572° F.) Faust and Homeyer, however, obtained from the oil about 60 per cent. of a terpene, $C^{10}H^{16}$, boiling between 172° and 175° C, (342.6° and 447° F.), 30 per cent. of cymol, $C^{10}H^{14}$, the remainder being a terpene boiling at 150° C. (302° F.), and an oxygenated compound, probably $C^{10}H^{19}O$, which they named eucalyptol, Cloëz's compound of the same name, being a mixture of the first two hydrocarbons, which rapidly combine with oxygen. The oil of *Eucalyptus amygdalina* does not appear to contain eucalyptol.

ON THE PHYSIOLOGICAL AND THERAPEUTIC ACTION OF EUCALYPTUS GLOBULUS.

If extensive applicability and promptness of action are the criterion of a standard remedy, the preparations of Eucalyptus globulus, have an unquestionable claim to be included in this category. Still, looking over an apothecary's prescription file, we would be surprised to find how rarely this drug is exhibited. To those, however, familiar with the clinical employment of the remedies in question, it must be clear that the practitioner's lack of practical acquaintance with, and confidence in, the drug, rather than any want of therapeutic energy on the part of the plant, have caused the condition. There can be no doubt as to the medicinal virtues of the various preparations of Eucalyptus, when we consider that the tree itself, in its natural state, medicates by its powerful antiseptic properties a wide zone encircling its habitation.

We have noticed* a series of interesting articles on the medicinal virtues of this justly prized tree, from which we extract some practically important matters.

According to Chipier, the author of the papers quoted, the well-known disinfectant properties of the tree depend upon an essential oil contained in the leaves. The aromatic oil found in the other portions of the tree is credited with the other therapeutic effects of Eucalyptus. The action of eucalyptol and eucalyptene, two other components of the Eucalyptus tree, have hitherto been but little studied.

In France five different preparations of Eucalyptus are in use, viz.: 1, a tincture made by an alcoholic maceration of the fresh leaves ; 2, a tincture obtained from the dry leaves by the same process ; 3, an alcoholic extract ; 4, a wine ; 5, a liniment prepared from the essence. It is interesting to note that the preparations used in Italy against the marsh fevers in Rome and its vicinity all come from a place called Trois-Fontaines, and have the form of a highly concentrated ethereal extract and an alcoholic elixir. The physiological action of Eucalyptus is sufficiently interesting to repay us for briefly reviewing it.

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* La France Medicale (Nos. 43, 44, 45, 1885.)

All preparations are marked by a peculiar strong odor, suggesting the essence. If a few drops of any Eucalyptus preparation are placed on the tongue, a sensation of pungent freshness, soon followed by one of warmth, is experienced, the latter being due to an hypersecretion of the salivary and buccal glands. Its ingestion into the stomach creates a similar sensation of warmth, and besides, an emission of its characteristic odor by the mouth. The urine reveals a faintly violet coloration, indicating the passage of the drug through the system.

The fact that Eucalyptus, like balsams and essences, impregnates the mucous membranes in particular, suggests at once the utility to be derived from the drug in inflammatory conditions of the respiratory and urinary mucous passages.

Larger doses of the drug produce headache, malaise, general fatigue and prostration, and, even, as shawn by Gimbert, fatal results in animals by paralyzing the reflex motor centres of the spinal cord.

From the manifold therapeutic applications which Eucalyptus has found in the course of time, we will only review such as have earned a claim to our confidence.

Rumel is to be credited with having first suggested the idea of planting the tree with the view of thus ridding a territory from the baneful marsh and malarial fevers. The same object led to its cultivation in the English Cape colonies and the western shores of Middle Italy. It was this ingenious transplantation of the Australian tree to the vicinity of Rome that enabled the Trappist of Trois-Fontaines to recover and render inhabitable a vast area formerly exposed to the ravages of malaria. It is highly probable that the disinfectant power of the tree depends upon its capacity to absorb large quantities of water from the surrounding soil, and to thus dessiccate the germs of malaria. The success of this soil medication in Italy, Algiers, Cuba and South America naturally suggested the employment of Eucalyptus in intermittant fever. Of an infusion of 8 grammes (2 drachms) of the leaves in 120 grammes (5 oz.) of water, a cupful is usually given twice daily. It is well to remember the antiperiodic virtues of Eucalyptus in cases in which quinine has either failed or is contraindicated. In fact, Eucalyptus is better borne by the digestive system that quinine, fatigues the stomach less and is far less expensive. Still it would be wholly erroneous to think of any possible therapeutic equivalence of Eucalyptus and quinine. An honorable and noteworthy rank as an auxiliary remedy in miasmatic fevers is all that can with propriety be claimed for the preparations of Eucalyptus.

This statement that Eucalyptus asserts its antipyretic character also in the thermal elevations of tuberculosis and cancer appears, if true, to us all the more noteworthy, as its virtues in this direction have been almost generally overlooked.

Important as the antimiasmatic and general antipyretic properties of

Eucalyptus unquestionably are, it is in the laryngeal and bronchial inflammatory affections that the drug renders its most signal services. Its action in this respect rivals that of turpentine and tar, and even offers advantages in being better borne by the digestive organs, and being earlier administrable. When in the course of bronchitis the febrile elevation has fallen and the so-called catarrhal stage has been reached, Eucalyptus positively diminishes the expectoration, and renders it less purulent. This peculiar effect of Eucalyptus on the bronchial expectoration can be relied upon, especially in the fetid form of bronchitis, in bronchial dilatation, and emphysema. Chipier quotes several cases of pulmonary gangrene and tuberculosis in which this modification of the expectoration wrought by Eucalyptus was very obvious.

A few more words on the special value of the drug in pulmonary consumption will not be out of place. Though no rational physician will look for any specific or even curative virtues regarding consumption in Eucalyptus more than in any other drug, it must be confessed that the peculiar combination of antiseptic and anticatarrhal properties places Eucalyptus at the head of all remedies from which any amelioration of the local tissue-decomposition can be expected. In Italy the drug enjoys the enviable reputation of positively benefiting tubercular patients. Dr. Gimpert, of Cannes, a well-known specialist of that famous tubercular sanitarium, expresses himself in terms of highest praise of Eucalyptus in the various tubercular processes. He warns, however, against exhibiting the drug in too large doses, lest hæmoptysis should set in.

Without wishing to contradict the assertion of those physicians who succeeded in obtaining definite advantages from Eucalyptus in tubercular affections, we must express our astonishment that, provided the drug did possess the alleged capacity, such effects should have been wholly unknown in this country. At all events it appears advisable to exhibit the various preparations of Eucalyptus in the manifold affections in which its reputation is either firmly established or merely alleged. It will do no harm in either case, and might be conducive to valuable results in both.

The value of Eucalyptus in the various catarrhal affections of the urino-genital apparatus is likewise great.

THE MEDICINAL PROPERTIES OF EUCALYPTUS.*

The leaves are of a bluish-green color, and have an aromatic, balsamic, and somewhat persistent bitter taste, increasing the flow of saliva. The swallowed juice imparts a pleasant feeling of warmth to the stomach, increasing the appetite and facilitating digestion. In health, full doses are said to cause sleeplessness, but in the weak and anæmic, drowsiness and sleep are said to follow.

* Therapeutic Gazette, 1880, p. 446.

Eucalyptus is powerfully antiseptic and anti-malarial. Mixed with albumen and fresh fibrine, its essential oil, Eucalyptol, prevents decomposition, and animal tissue treated with it may be dried and mummified by simple exposure to the air. The tree has wonderful anti-miasmatic properties. Planted in marshy districts, it absorbs the excessive humidity of the soil, and with the drying of the morass there is a disappearance of the malaria. Gimbert estimates that the tree extracts from the soil ten times its own weight of water during the twenty-four hours. Outside of its native habitat, this property of the tree has been successfully tested in Algeria, in the notorious Campagna di Roma, in the delta of the Var, near Nice, and in California. Districts which were uninhabitable have been made healthful and entirely free from malaria by the planting of these trees.

Therapy.—Locally: Applied in the form of a mixture of an ounce or more to a pint of tepid water, it is an admirable stimulating disinfectant to chronic, ill-conditioned ulcers, removing the fœtor of the discharge and improving the character of the secretion. A mixture of half this strength may be used with excellent results in vaginal leucorrhœa, and particularly when there is erosion and ulceration of the os. As an antiseptic and a corrective of the fœtor from decomposition of retained placenta, a similar injection is useful. A drachm or two of the fluid extract rubbed on the hands will remove the persistent odor caused by vaginal examination, in such cases as the above. Pencilling of the fauces and pharynx with the fluid extract in diphtheria, both gives relief to the patient and is an efficient deodorant. The inhalation of the spray from the steam atomizer is a valuable adjunct to the treatment of diphtheria, and also as a palliative in purulent bronchitis and phthisis.

Internally. In intermittent fever. The marked influence of the tree in ridding districts of malaria, suggested the internal administration of Eucalyptus globulus in malarial disorders. The trial to which it has been submitted has established it as an anti-malarial remedy of much power, and even as a formidable rival to quinine in certain cases. While in more recent and pronounced attacks of the disease, its action is not so prompt or certain as that of quinine, it is more effectual in the chronic forms. Especially in districts in which the patient is continuously exposed to the malarial influence, and in cases in which quinine has apparently lost its power to avert or abort the paroxysm, is the superiority of Eucalyptus globulus demonstrated. The following combination is a most admirable one in the debility of cachexia ensuing on the prolonged effects of the malarial infection:

℞	Ext. eucalypti globuli fluidi	℥j
	Ext. berberis aquifolii fluidi	℥j
	Ext. taraxaci fluidi	℥ss
	Glycerinæ	℥jss.
M.	Sig.—A teaspoonful every four hours.	

In diphtheria. A number of cases of diphtheria have been reported by reliable physicians, in which the exhibition of Eucalyptus globulus exerted a very beneficial effect. Its local application is certainly attended with good results, but its internal use in this disease has been too limited to justify any very pronounced opinion regarding it. As an adjuvant to other remedies, it would seem from its antiseptic properties, and from the fact that it is largely eliminated through the mucous membranes, to be worthy of a more extended trial.

In atonic dyspepsia and in chronic gastric catarrh, Eucalyptus is a very useful article. It may be combined in such cases with columbo. It should not be given in inflammatory conditions of the stomach.

In chronic cystitis there is probably no remedy of equal efficacy with Eucalyptus globulus. It evidently acts in such cases through contact with the membrane, it being largely eliminated through the urine, to which it communicates its characteristic odor. In such cases, attended as they are by profuse secretion of the mucus with the urine, and by inability to retain the urine for any length of time, the following combination has been found to be followed with very happy results:

℞	Ext. eucalypti globuli fluidi	ʒvj.
	Ext. belladonnæ fluidi	ʒss.
	Ext. buchu fluidi	℥ss.
	Muc. acaciæ	℥ij.
	Ol. cinnamoni	gtt. vj.
	Ft. emulsionem.	
M.	Sig.—A teaspoonful every three hours.	

As an antiseptic in surgery. This application of Eucalyptus globulus is somewhat new, but its results have been of such a nature as to warrant a more extended trial. Dr. Floyd, of Sedgwick, Kansas (See Report 9, page 668) has made experiments, therapeutical and otherwise, which certainly indicate it to be possessed of properties which give promise of valuable results in the surgical treatment of wounds. As an illustration of its value, he reports among others a case of compound comminuted fracture of the forearm, necessitating amputation. The sponges and bandages employed during the operation, were soaked in a 20 per cent. solution of carbolic acid, and the stump was enveloped in several thicknesses of cheese cloth, which were kept constantly saturated in fluid extract eucalyptus one part to seven of water. This was the only dressing, and 10 days after the operation, the stump had healed without pain or suppuration, and the patient was discharged. Dr. Floyd has found no dressing equal to it in the treatment of lacerated wounds. His experiments with different preparations of eucalyptus, on hay infusion, have fixed the antiseptic properties of the drug in its resinous constituent, preparations from which this principle had been removed, having had no preventive influence against putrefaction.

Administration.—The fluid extract is the most eligible form, and contains most largely the medicinal principles. The dose is from 10 to 30 drops, and may be given in form of an emulsion, with syrup of acaciæ.

MATERIA MEDICA OF THE EUCALYPTUS OILS.*

The first effect of the oil when taken internally to the extent of 10 to 20 minims, is to stimulate the cerebro-spinal nervous system, large doses produce genuine intoxication which passes into unconsciousness and heavy sleep; the reasonable antidote for an overdose is therefore a cup of strong coffee. The oil possesses more powerful antiseptic properties than phenol (carbolic acid), and is accordingly used in an antiseptic spray, and for antiseptic dressings; it is not so irritating as phenol, but possesses sufficient inflammatory power to render it a good rubefacient if applied with friction. Considering its powerful antiseptic effect, its poisonous action when taken internally is remarkably mild, so that there is no danger from its absorption by even a large wound surface; when it is carefully purified as much as ¼ oz. can be taken diluted with no more serious results than considerable depression. An idea of its antiseptic powers may be gathered from the fact that 1½ parts in 1000 arrest the development of bacteria in a vegetable infusion. Its effect on the blood is powerful, it diminishes the power of the red corpuscles to absorb oxygen, as can be shown by the darkening of red blood when even very dilute eucalyptus oil is added to it; it also destroys the contractility of the white blood corpuscles. Many small animals are paralyzed by the mere vapor, so that the value of the eucalyptus oil as an anthelmintic or vermifuge can be understood. The following formulæ were given by Mr. Bosisto in a paper on the "Materia Medica of the Eucalyptus," published in the Australian Medical Journal, 1885, p. 441:

For rheumatism, sciatica, lumbago, asthma and sprains requiring a strong liniment:

℞	Ol. eucalypti	℥ iv.
	Vaseline	℥ ij.

Misce.

For the throat when it requires a mild liniment:

℞	Ol. eucalypti	℥ iij.
	Ol. olivæ	℥ j.

Misce.

The addition of the olive oil prevents irritation of the skin. The vaseline is to be warmed before mixing.

In its internal use for coughs, asthmatic difficulty of breathing or sore throat, 5-drop doses on loaf sugar are recommended to be taken occasionally. For stronger doses:

℞	Ol. eucalypti	ʒ j.
	Pulv. gum acaciæ	ʒ iij.
	Saccharum	℥ ss.
	Aq. cinnamon ad.	℥ iv.

Misce. Dose, one-half ounce for an adult every four or six hours.

* Wm. Sutherland, M. A., B. S., in the Chemist and Druggist, March, 1887.

Or the follwing may be used :

℞	Ol. eucalypti	ʒj.
	Infus. lini	℥iiss.
	Syrupus	℥ss.

Misce. Dose as above.

As an anthelmic 30 to 60 minims of the oil in mucilage of starch are to be administered by enema.

On the continent a eucalyptic tincture is the commonest form in which eucalyptus oil is used, but besides the oil this contains a bitter febrifugal principal, and traces of resins and acids which in the ordinary process of distilling eucalyptus oil are kept back in the mother liquor of the stills. The tincture is prepared by bruising three ounces of fresh leaves, and covering them with six ounces of absolute alcohol, in which they are digested at a moderate temperature, in a well-closed vessel, for fourteen days at the end of which the leaves are well pressed and the liquid filtered. This preparation has decided antipyretic properties, a fact which along with its bitter taste led its first investigators to believe that eucalyptus leaves contain an alkaloid like those of the cinchona bark, but this idea was soon dispelled. However, there is no doubt that this tincture possesses some of the properties of quinine ; thus by actual experiment it has been found to exercise a contracting effect on a dog's spleen, which is the action of quinine. In cases of malarial fever eucalyptic tincture is considered to rank next to quinine as a remedy ; in many cases where quinine fails it proves successful, and it possesses the decided advantage of being much cheaper and less troublesome in its after-effects. In the continental preparations of the above tincture the leaves of *Eucalyptus globulus* are always used, but there is no information to be had as to the tinctures to be obtained from the leaves of other oil-yielding species. As has been said before the name *globulus* carries a glamour with it which there is no proper experimental evidence to justify. Until the systematic details of comparative experiment are given, the preference given to globulus preparations must be regarded as arbitrary and accidental. There is certainly room here for an interesting piece of pure pharmaceutical research which ought to occupy the attention of some of our more scientific Australian pharmacists.

CLINICAL REPORTS OF THERAPEUTIC PROPERTIES OF EUCALYPTUS.

Reports of a General Character.

Report 1.*—As to the therapeutics of Eucalyptus. Quite a volume could be collected of the reports of successful cases. We spare you most of this, and give only some of the more important and practical tests, or new uses of the drug.

* C. Henri Leonard, M. D., in New Preparations, 1877, p. 6.

Dr. Wooster, of San Francisco, California, in a report of 136 cases of various diseases treated exclusively with fluid extract of Eucalyptus globulus, gives the following results :

	Treated.	Cured.	Improved.
Remittent fever	5	5	..
Intermittent fever	19	19	..
Typhoid fever	9	9	..
Nephritis	4	3	1
Diuresis	10	7	3
Incontinence of urine	3	3	..
Vesical catarrh	27	25	2
Blennorrhagia	13	10	3
Valvular disease of heart	7	0	7
Dysentery	4	3	3
Chronic diarrhœa	13	9	4
Gonorrhœa (syphilitic)	15	10	5
Dropsy	6	3	3

Of the whole number of cases, 106 were cured and 29 improved.

Dr. Keller, physician-in-chief of the Australian Railway Company, reports the following cases, with results, as treated with Eucalyptus: The total number of malarial cases was 432. Of them, 310, or 71.76 per cent. were cured; 122 required a supplementary course of quinine. Of those cured (310), 202 needed but a single dose of the remedy (the tincture); the remaining 108 cases had one or more subsequent paroxysms. Quinine had been given previous to the Eucalyptus in 110 out of the 432 cases. Of the 122 cases in which the remedy failed, 58 were cured with quinine, 10 were sent home, 16 remained under treatment, and 38 remained in *statu quo*. Out of the 118 cases in which quinine had been previously given but failed in arresting the disease, 91 recovered under the influence of Eucalyptus, the remaining 27 were not benefitted. The several types of fever were as follows:

	Complicated.	Simple.	Total.
Quotidian	117	73	190
Tertian	126	95	221
Quartan	16	4	20
Quintan	1	....	1

The complications were splenic and hepatic engorgements, anæmia, chronic gastric catarrh, paludal cachexia, etc. The remedy proved itself successful in 161 (61.9 per cent.) of the complicated cases, and in 149 (86.6 per cent.) of the simple cases. Cures classified according to the types, we find successes in the tertian to have been 75.57 per cent., in the quartan 70 per cent. The remedy in a single dose arrested the disease in 107 simple and 95 complicated cases. The treatment was generally commenced on the fifth day after the paroxysm, and the average duration was but 9½ days, whereas in previous years when quinine was employed 12½ days was the average time of treatment. The tincture was made by macerating the leaves in alcohol for three months. Ten pounds of the leaves yielded 25 quarts of the tincture. The average dose was two drachms, and the average quantity used per patient was seven drachms.

Dr. Burdel has employed it in 50 cases of quotidian, 39 of tertian, and 34 of quartan ague. The powder, tincture and solid extract were

made use of. In 57 cases he derived no benefit. The treatment extended from five to ten days. The extract in 10 to 12 grains, daily, was found most beneficial in preventing relapses; this was given for five or six days after the arrest of the paroxysm.

Castan reports 33 successful cases out of a total of 44 cases treated with the drug. Mees, out of 35 cases had 13 cured, 10 greatly benefitted, and 12 partially relieved.

Lorinsen cured 43 cases out of 51 to whom he administered the tincture as an anti-periodic. In one case of failure, both it and quinine were unavailing. Bohn reports a case of a child with a masked intermittent, with cerebral complications. where the tincture in drachm doses proved successful in relieving the symptoms for four hours, and he recommends it in puerperal fevers. Boyce details a case of ague that had resisted quinine and arsenic, and was cured by the Eucalyptus in four days. He has used with great success in catarrhal affections of the urethra. The oil he recommends as of use in odontalgia. Curnow, of London, speaks of a Norwegian that had been five weeks with an attack of ague, tertian type. The temperature was from 104 to 105.6° F. at the acme of the fever before the administration of the tincture of the drug. The administration was commenced on a day preceding an attack, and given in drachm doses *ter in die;* it modified the attack on the following day so that the highest temperature of the paroxysm was but 100° F., instead of the customary 105°. No further return of the paroxysm was noticed. In another case, a Dane, was admitted to the hospital after an attack of five days duration, with severe paroxysms, lasting some twelve hours each time. The highest point of temperature reached at each attack was 106.4°. One was tertian type, and just before the next attack was due, the administration of Eucalyptus was begun, in the same dose, etc., as before. The next two attacks were modified in their severity, and were much shorter; the dose was then doubled, and he had but a single attack following this date.

In the external application of the Eucalyptus, equally good reports have been universally given, and it is more especially to this use of it that we would now call your attention. In the United States this has not been so much dwelt upon as on the continent, probably through lack of its employment as an external remedy. As a stimulant to foul, or gangrenous ulcers, bedsores, and in cases of vaginitis, offensive leucorrhœa, chronic bronchitis and the like it is one of our best vegetable preparations. Dupuytren (Pigne) details a few of the cases in which he has made use of it in his hospital practice. A man had arteritis of the leg, succeeded by gangrene. which extended so high up as to render amputation impossible. In two weeks a large ulcer resulted, whose odor was horribly fetid. Everything in turn was employed to destroy this odor, to no offect. At last a decoction of Eucalyptus was resorted to, and, with-

out exaggeration, he states, in five minutes all fetor had disappeared. The decoction continued to be used with the same effect until death occurred, two or three weeks subsequently.

Another man, who had been under treatment in the hospital for two months with extensive, deep ulcer from varix, of a year's duration, had the decoction applied to the ulcer three times a day, with remarkable effect. In five or six days the ulcer was entirely covered over with healthy granulations, and in a month it was entirely well.

A woman had been troubled for many months with an ulcer around the orifice of the urethra. It was cauterized five times with no result. After twelve days' use of the decoction of Eucalyptus, washing thrice daily, it was well.

Four cases of syphilitic chancres healed under the Eucalyptus dressing in five or six days, without other treatment. These were very recent cases, or constitutional treatment would have been resorted to.

A man that had an intermittent fever that had proved rebellious to quinia, and also to arsenic, which latter had been administered for two weeks, after a three weeks' course of the Eucalyptus was cured entirely.

So numerous are the cases of bronchitis cured with the drug, he states, that it is hardly worth while to mention them.

Woodward has used the tincture as a disinfecting and antiseptic enema in case of retained and decomposed placenta with marked success. Also in a case of putrid dysenteric passages, the Eucalyptus given internally changes the offensiveness of the stools, besides checking their frequency. In a case of diphtheria where death was supposed to be inevitable, the local application relieved the fetor, and assisted in checking the further spread of the disease. He has also employed it in a single case of neuralgia dependent upon the malarial taint. Other remedies were fruitlessly tried before resorting to the Eucalyptus. In twenty-four hours the relief was permanent. He gave it in fifteen-drop doses.

Leary, in a recent discussion before the "King's County Medical Society," says that for four years he has used it as nearly a specific in gonorrhœa. He noticed then its great diuretic powers, and so has since given it, in ten-minim doses of the fluid extract, in cases of dropsy. He briefly reports four, one due to *Morbus Brightii*, another to cardiac hypertrophy with dilation, the third to cardiac disease, and the fourth to cardiac hypertrophy, where remarkable success followed its administration. He has also made frequent use of the remedy in passive congestions of the kidneys, and always with benefit. He noticed that sometimes his patients would complain of *tinnitus aurium*, and headache from the passive cerebral congestion.

Wooster states that he has used gallons of the fluid extract in the U. S. Marine Hospital, and was surprised at its uniform and reliable effect in the diseases for which it is recommended. He certifies that it is a

diuretic, and may be administered when others are admissible. It is an aromatic tonic, and as such specially indicated in low states of the system as we see in typhoid fever, diarrhœa and dysentery. In vesical catarrh it has proven a reliable remedy in his hands, and many cases of gonorrhœa, he says, he has quickly cured by the use of this remedy alone. Indeed, in all affections of the mucous membranes its beneficial action is noticed. As an external application to foul ulcers he avers, it is of great value.

Limbert has successfully treated wounds by the application of the fresh leaves to the parts. After a few hours all the unpleasant odor emanating therefrom is counteracted and a healthy state of healing goes on to complete cicatrization.

Bucquoy (of Cochin Hospital, Paris) asserts that of all the drugs he has made use of in pulmonary gangrene, none have given him the satisfaction that Eucalyptus has. Out of the various cases treated, five were complete cures, while the symptoms of all the others were favorably modified. The cough modified, the sputa was less abundant, and the offensive odor was entirely absent, and this after carbolic acid had failed. He uses it in the form of an alcoholate, half a drachm in a mixture of syrup, gum and orange-flower water.

These anti-septic properties of Eucalyptus are due, mostly, to the oil (eucalypto) contained in the various preparations made use of. It (the oil) has been known to preserve blood for over five months from decomposition (as long as carbolic acid will do the same), which is longer than turpentine will keep it unchanged. Limbert and Birch have both made experiments to this effect, and both confirm the statement. The action of the remedy upon the white blood-corpuscles is analagous to that of quinine, as it restrains their amœboid movements, and hence its usefulness in the class of troubles, congestive in their nature, where it may be locally applied.

As an item of agricultural interest it may be noted that it has been asserted by the French writers to be a remedy for phylloxera; that trees growing near the grape-vines protect the vines from the ravages of this parasite. Experiments have also been made with the essence of the drug upon the diseased vines, by Abbe Rolland, in the manner of innovulations, and with such success that he has pronounced, after a trial of two years of its virtues, "an infallible remedy." He makes a broad incision through the bark at the neck of the vine, and into this drops a few drops of the essence, or rubs it over the cut surface with a camel's hair brush. The result is, as he says, that in three or four days the parasites are destroyed, but the vine remains uninjured. The incision may be made in any part of the bark, but the desirable result is most speedily obtained by making it as near the roots as possible.

REPORT 2.*—In the the internal administration of eucalyptus as a remedy for malarial fever, we do not have one uniform and universal application; still it compares favorably with other remedies in general use. If I had written this article after the first six months' experience in its use, I might have said that it absolutely cured all forms and conditions of active malarial poisoning, for it did so in every instance in scores of cases and in all forms, from simple intermittent to "dumb ague," and in several cases by a single dose. So uniform was its action that I felt confident we had at last an unfailing remedy, but since the first year I have failed in many instances with the same preparation—the tincture.

Hence it seems to me that it partakes of the nature of other remedies in respect to particular seasons and localities for its better action. Eucalyptus, however, has acted promptly when quinine has failed. I first employed it in a case of masked intermittent, in which the poison had had pretty much its own way for three months, and in which quinine and arsenic only produced temporary mitigation, while gelsemium, nux vomica, ipecac, and nitric acid seemed powerless to touch the slightest symptoms, and where the first dose of eucalyptus wrought an entire change. The remedy was taken at the time of the chill, and the fever did not follow. The patient soon recovered her strength, and has since had no return of ague symptoms—now over three years. This is contrary to the opinion of some that it has no effect on chronic forms of malarial fever.

Eucalyptus is also recommended in all catarrhal affections of the air passages, from the common coryza to chronic bronchitis, and of the alimentary canal, ulcers in the stomach, chronic diarrhœa, and in the diseases of the urinary tract, such as inflammation and irritation of the bladder, gonorrhœa and gleet. I have found it of special benefit in irritable bladder. One case that lately came to me from Fountain county, Indiana, in which belladonna and camphor relieved her perfectly, while in this city, but on her return home the irritability came on with double force, eucalyptus gave immediate relief. She being a very intelligent lady, I will copy a portion of her letter, dated Dec. 4th, 1880:

"I am quite free from distress and able to work the early part of the day, but about 3 in the afternoon the 'ache' begins; there is a constant desire to pass water and a strained, protruding feeling at the neck of the bladder; then follows a fearful itching, scalding, aching sensation, which well-nigh drives me frantic.

'After a time of suffering which is exhausting, the distress subsides. I eat heartily but so bruised and beaten do I fell that I can only take the edge of a chair for rest. I have such a time, also, every night, being obliged to get up every few minutes to pass a few drops of water, and the

* Dr. H. A. Foster in the Phys. and Surg. Inv. (Therapeutic Gazette, 1880, p. 223).

passage is often agonizing. There seems to be about the same quantity, though at times it is strong and high-colored."

We have here pure irratibility, and half-drachm doses of fluid extract of Eucalyptus quickly controlled the trouble, as she states in a letter dated december 23d :

"I have found out the benefits of Eucalyptus in my case. Its relief came most opportunely, for I don't know how I could much longer have endured the terrible strain of the bladder difficulty, and I am so happy to find a balm for that," etc., etc.

I have obtained good results, also, in several cases of incontinence of urine, and in some cases of gonorrhœa I consider it superior to copabia and the oil of sandalwood. It seems to relieve the pain and scalding more promptly, and reduce the discharge sooner than they.

I have seen good results in chronic bronchitis from its use. I usually use the fluid extract for urinary troubles, and the tincture for malarial fevers and bronchitis. Dose of each, about half a drachm.

REPORT 3. †—I have given Eucalyptus with much satisfaction as a gargle in ulcerated sore throat; also as a gargle, and combined with jaborandia internally in a number of cases of scarlatina, with results so good as to justify "great expectations."

In two very severe cases of typho-malarial fever, the first of which was a lad of fourteen years, quite feeble from hereditary phthisis; the second a boy of four years, who had suffered so long from chronic malarial poisoning that his nervous system was completely prostrated, and he would scream with terror at the approach of any person, even his mother; I resorted to the fluid extract of Eucalyptus after having pursued the ordinary anti-periodic treatment with no apparent benefit, and I had really lost all hope of their recovery. The first twenty-four hours showed a marked improvement, which continued under its use without interruption to complete recovery; during this time no other medicine was given.

I have also used the fluid extract as a vaginal injection in blenorrhœa, leucorrhœa, and kindred affections; also in gonorrhœa in both male and female, of the strength of one part of fluid extract to seven of water; the addition of a little glycerine is usually desirable.

I much prefer this wash in these affections to any dilution of carbolic acid, the indiscriminate use of which is accountable for much mischief. In erosions of the cervix uteri, without ulcerations, I used the fluid extract undiluted as a local application with benefit.

REPORT 4.*—Have used Eucalyptus Globulus in connection with sulph. cinchonidia, in malarial fevers; also when indicated in typhoid; have also used it with marked success in uterine diseases, as an injection, and in nasal catarrh for a douche.

† T. S. Floyd, M. D., in Kansas Medical Index (Therapeutic Gazette, 1890, p. 309).

* H. J. Hilton, M. D., of Ann Arbor, in New Preparations, 1878, p. 64.

The following telegram appeared in the papers too late for verification:

FOR YELLOW FEVER.

BRAZILIAN PHYSICIANS SAID TO HAVE DISCOVERED A CURE.

(Scripps-McRea League Special Service.)

Buenos Ayres, January 29.—Rio Janeiro advices state that a physician of that city declares that he has found a cure which is almost certain in its effects in yellow fever. The physician's new remedy consists of the internal use of doses of the extract of eucalyptus. The extract has been tried in the hospitals in Rio Janeiro with astonishing results in favor of the patient.

Besides these general reports there are a number of reports on special uses of Eucalyptus preparations favorable to their value.

EUCALYPTUS KINO.

Prof. J. H. Maiden divides the Eucalyptus kinos into three classses, viz., the Ruby, Gummy and Turbid.

The members of the first of these are soluble both in alcohol and water, giving a ruby colored solution; those of the second are practically insoluble in alcohol, and the third, when treated with hot water and allowed to cool, contains a body or bodies which render the liquid turbid."

The only analysis I have seen of these kinos is by Prof. Maiden and of his turbid group. This is the largest of the groups and includes, amongst others the following species well known here: Eucalyptus melliodora, Eucalyptus leucoxylon, Eucalyptus cornuta, Eucalyptus rostrata, Eucalyptus viminalis, Eucalyptus Stuartiana, Eucalyptus Gunnii, Eucalyptus longifolia, Eucalyptus calophylla, Eucalyptus globulus. I give the following analysis from Prof. Maiden.

Eucalyptus corynocalyx.

It does not entirely dissolve in cold water; the supernatant liquid is pale yellowish, and it does not entirely dissolve in alcohol; the liquid becomes clear on standing, but on agitation has a very turbid appearance. Its composition (determined August, 1891) is:

Catechin and tannic acid	82.473
Ligneous matter, etc	3.827
Moisture	13.370
Ash	.332
	100.000

Tannic acid determination (Löwenthal), 26.2 per cent.

Eucalyptus Leucoxylon.

Behaviour and appearance in water similar to Eucalyptus corynocalyx sample. In alcohol it does not entirely dissolve; the supernatant liquid is bright, clear, and of a reddish-brown color; the liquid is very turbid when agitated. Its composition (determined August, 1891) is:

Catechin and tannic acid	79.279
Ligneous matter, etc	4.9
Moisture	14.95
Ash	.871
	100.000

Tannic acid determination (Löwenthal) 21.5 per cent.

Eucalyptus rostrata.

The well known "Red Gum" of Victoria and the Murray and Edwards Rivers, N. S. W.

The kino of this species is perhaps the best known of all Eucalyptus kinos, chiefly through the enterprise of Mr. Joseph Bosisto, of Melbourne.

It is a useful astringent, and it seems to be increasing in favor with medical men in England, America and Australia.

The official kino (Pterocarpus) contains, I believe, no substance which is not contained in this and some allied kinos, for which they appear to be a perfect substitute. See Pharm. Journal [3], xx. 221, 321.

The kino of Eucalyptus rostrata will be found mentioned in all modern works on Materia Medica. In Martindale and Westcott's Extra Pharmacopœia, for instance, we have the following: "Eucalyptus rostrata and Eucalyptus corymbosa, and probably other species imported from Australia. It is semi-translucent and garnet-colored, not so dark as, but resembling kino in appearance, soluble in water, tough, difficult to powder [not correct as applied to these two kinos, J. H. M.], it adheres to the teeth when chewed, is intensely astringent to the mucous membrane, useful in diarrhœa, relaxed throats, and given with success to check the purging of mercurial pills."

But the following statements pertaining to the percentage of tannic acid, and the solubility, are somewhat misleading, since I have shown the enormous variation in the properties of kinos caused by age.

"Of 100 parts 90 are dissolved in cold water, the solution being clear. Twenty-seven parts of isinglass precipitate all the astringent matter."—Squires' Companion to the B. P.

Dr. Weisner says of a sample: "Easily soluble in water and alcohol; solution neutral, free from gum-resin. Broken masses of a zircon-red, sometimes light brown, mixed with bits of dark."

47. "Red Gum;" purchased in Sydney, 22nd November, 1888. Of Victorian origin.

In lumps up to the size of peas, though angular. Prevailing color purplish brown. Is readily powdered between

the fingers, forming an ochrey-brown powder. The mass of kino has not the brilliant appearance of the kinos of the ruby group, owing to this friability.

In cold water it dissolves fairly readily and almost entirely to a reddish-brown liquid. Its composition (determined November, 1888) is:

Catechin and tannic acid	84 3
Ligneous matter, etc	.3
Moisture	15.2
Ash	.2
	100.00

Tannic acid determination (Löwenthal) 46.22 per cent.

HOW TO PLANT EUCALYPTUS.

The first thing to consider in planting Eucalyptus trees is the seed. With the exception of only four or five species seeds true to name are difficult to obtain. Consequently when species are desired that are outside of the ordinary demand it is best to have the seed collected here from identified trees whenever the tree is locally represented. In this connection it should be borne in mind that the seeds in the top of the ovary are nearly all fertile while, as you go down, the ratio of fertile to sterile seeds diminishes: The top seeds are first dropped, so in collecting seed the fruit should be gathered just before it opens and allowed to ripen up in sacks or boxes.

The seed germinate most uniformly when soaked in warm water for 24 hours. All the species from which seed have been locally gathered in California have, as far as reported to me, proved fertile. In Algiers, Eucalyptus tetraptera, is the only one reported sterile. While the seed

planting method is the only practical way to rear Eucalyptus trees in my opinion, still a large number of Eucalyptus species have been propagated from cuttings. In fact in the report I have on this subject no species tried proved absolutely recalcitrant.

When the seed have been obtained I would advise the intending planter to place the rearing of the plants for the field in the hands of a competent nurseryman. In Southern California we are very fortunate in having a number of careful and competent nurserymen. Amongst these I can mention Mr. W. S. Lyon, a botanist and former Forester to the State, and J. L. Stengle, both of Los Angeles, the Park Nursery and the Paradise Nursery, Pasadena, and Dr. Francischi, a plant lover, of Santa Barbara.

In case however the planter desires to overlook or undertake the whole planting I present some notes from the distinguished forest conservator, W. S. Gill, and a paper from Mr. Byron O. Clark. Mr. F. M. Gallagher of the Mentecito, plants his seed in coal oil cans cut in half and transplanted to the field from these direct without a preliminary picking out.

The grower, as a check, might well refer to the accompanying illustration of the seedlings of a number of the species.

My own experience with Eucalyptus tree planting is that the land should be plowed and the cultivation continued to the second season. The planting of Eucalyptus trees amongst our native Californian brush has proved, in general, a failure. The Eucalyptus trees planted without clearing usually live, but remain stunted or for a number of years grow very slowly. I have some Eucalyptus globulus planted amongst oaks, sycamores and willows

CALIFORNIA

From Von Mueller

KEY TO PLATE OF SEEDLINGS.

Young seedlings of Eucalyptus, to exhibit mainly the cotyledonar leaves.

1—E. diversicolor
2—E. leucoxylon
3—E. rostrata
4—E. botryoides
5—E. cebra
6—E. cornuta
7—E. Gunnii
8—E. corymbosa
9—E. marginata
10—E. obliqua
11—E. gamophylla
12—E. pilularis
13—E. saligua
14—E. siderophloia
15—E. goniocalyx

[All figures of natural size].

From Von Mueller

KEY TO PLATE OF SEEDLINGS

Young seedlings of Eucalyptus to exhibit mainly the cotyledonar leaves.

16—E. calophylla
17—E. melliodora
18—E. alpina
19—E. piperita
20—E amygdalina
21—E. macrocarpa
22—E Stuartiana
23 - E. Sieberiana
24—E. hemipholia
25—E globulus
26—E. stricta
27—E. cosmophylla

[All figures of natural size].

near a spring in the Sierra Madre mountains, that have grown in seven years what trees in adjacent open plowed land grew in one. M. Cordier reports from Algiers the satisfactory growth of nearly all species of Eucalyptus in ground prepared and cared for to the second year, and the failure to do anything of those set out amongst the native brush. Most species of Eucalyptus grow very rapidly when they are in the soil possession for the first two years. In that time they obtain a hold which subsequent native growths are unable to compete with, and the Eucalyptus trees continue their rapid growth which does not commence when these trees are set out amongst the native brush.

Eucalyptus trees should not, as a rule, be set out when over eight or ten inches high. In properly prepared ground six inches is the best size. This need of planting small trees fresh from the seed is one of the great advantages and economies of the genus Eucalyptus.

PASADENA, CAL., April 24, 1895.

ABBOT KINNEY ESQ.,
Lamanda Park :

Dear Sir :—Replying to your request for my treatment of Eucalyptus seed for propogating the young plants, will say : Nature's own seed bed is the best for all young plants, especially for small seeded plants and trees. I sow in flats, that is, boxes about three inches deep, and of convenient size for handling. I prefer 18 in. x 18 in. in size, with sufficient openings in the bottom to permit good drainage. Secure from the woods well decomposed leaf

mold and mix with one-third to one-half sharp sand such as would be used for mortar by the mason; fill your boxes level full and firm down with a board which will leave the surface about one-half inch lower than the edge of the box. Scatter the seed evenly and not too thick over the surface and cover about one-eighth inch with finely sifted soil same as used for the seed bed, press down firmly with a board and water lightly. Place boxes after sowing in a cold frame covered with cheese cloth, or in a lath house, and water lightly, daily, and not allow the surface to become dry. The seed of most varieties will germinate in ten to fourteen days, and in warm weather often the first plant will be out above the soil in six days. Water lightly when plants begin to show; great care will be necessary not to get soil too wet, or fungus will attack them and produce what is termed "damping off" by the gardener, which will often carry off seventy-five per cent. of the young plants before the second and third set of leaves appear, after which there is not much danger from this cause. I have found only one remedy of much use in preventing "damping," that is, to use the finest road dust, sprinkling it over the plants lightly on the first appearance of the trouble, which will often check its progress. Some varieties *may* be more subject to this trouble than others, but I think that conditions of weather favorable to producing succulent growth, the leading cause. Varieties showing least tendency one season, might suffer the greatest, under different conditions of temperature and humidity, another.

Before transplanting, the young plants should be hardened off, when about three inches high, by giving only sufficient water to prevent wilting in heat of day. After they have become sufficiently "ripened," or woody, apply water

freely, for three or four days, when on taking up the plants they will be found to be making a new root growth, shown by the young white rootlets. When in this condition they will nearly all grow when transplanted if carefully done and roots not exposed to the air and placed in shade for a few days till over wilting. I use the same sized box for transplanting into as for seed boxes, putting the young plants in with a dibble about two inches apart each way, but I use heavier soil for this purpose,—good clay loam, with a little well rolled manure, and enough sand or light soil to make it pliable is best, as it enables the planter remove the young plant with a squen of soil adhering to the roots, when transplanting to the field, which should be done when the plants are from six to twelve or fifteen inches high.

Yours Respectfully,

BYRON O. CLARK.

The better the soil is worked the better the tree will grow. General plowing is the best preparation of land for tree planting. Dug holes cost more and are not so good as a general breaking up of the soil.

We find Eucalyptus trees succeed well when planted from nursery boxes when the trees are 6 to 12 inches high. This is specially true of the blue gum. Trees cost more in cans or pots and do little if any better. They should be turned out of the pot, but may be left in the cans, which must then be cut down one side. Mr. Walter Gill recommends planting the seedlings in nursery in bamboo canes and setting the tree in the field with the bamboo intact. The bamboo soon rots and leaves the tree free and

the transplanting is practically without any exposure for the young tree. This method, however, is more costly in the nursery handling than our open boxes. From these the trees are taken and put into the ground as the planting progresses. At this time the boxes should be frequently sprinkled.

With care the percentage of failure is almost nil. A watering cart should accompany the planting and each tree be given water as it is set out. If this is inconvenient, or from circumstances too costly, a showery spring day should be selected for the planting, or days after the soil has been freshly rained on.

I have found it pay well to cultivate newly planted trees the first and second years of the planting. The vigor of the tree is thus increased and it obtains rapid and complete possession of the soil. I have seen plantations side by side, the one with two years cultivating and the other with none. Many trees were missing in the uncultivated piece, many were stunted in appearance, and the planting looked three or four years behind the cultivated one. The cost of cultivating should not exceed $5 per acre the first year and $2.50 the second and need not be so much.

March is as early as Eucalyptus should be planted in California,—May and June are better. The best time to set any evergreen tree is just as it is about to start a new growth. Large Eucalyptus trees are very difficult to transplant. A small tree is always safer and will quickly pass a large one that has been successfully moved.

The smaller the tree is when first set the less likely it is to blow over in after years.

Eucalyptus trees are generally surface rooters and when making rapid growth the first three or four years are some-

what subject to blow over in high winds after soaking rains. Trees must be protected from stock. Ground squirrels and rabbits must be cleared from tree plantations. This should be done before trees are set out.

In setting out streets or roadways where there are many foot passengers, Eucalyptus trees in large cans or boxes, say trees two to three feet high, may suit the conditions better than very small trees. Of course the cost is much greater both for trees and for planting, but it probably pays. In setting such large trees great care should be taken to see that the trees are not pot bound.

Mr. Walter Gill, in his pamphlet on tree planting in South Australia, speaks only of the following trees, all Eucalyptus. Eucalyptus globulus he reports short lived, and not suited to the prolonged dry heat of that colony. It grows there, however, with great rapidity for a few years, and is useful as a temporary windbrake or protection for better trees.

Eucalyptus corynocalyx sugar gum is a fine timber tree and hardy against everything but frost—sensitive to this. Makes good telegraph poles and stands well in the ground. Resists dry heat of interior better than other good trees.

Eucalyptus rostrata, best timber for lasting underground when of good quality—that growing on hilly lands more lasting than the bottom land trees, but subject to defects as gum veins and shakes. Not of extra good growth on dry plains in Australia.

Eucalyptus cornuta succeeds well in South Australia. Timber tough, useful similar to ash.

Eucalyptus leucoxylon (S. A. blue gum), valuable tree of timber utility, similar to sugar gum. Especially suited to limestone country which other trees do not like.

Eucalyptus sideroxylon (Victorian ironbark) suited to wheelwrights' work. Does well in South Australia. Mr. Gill speaks of the bark of sideroxylon as persistent on all the branches as well as on the main stem. (This does not seem to be the case in California). Little tree planting seems to have been done in Australia outside of this colony.

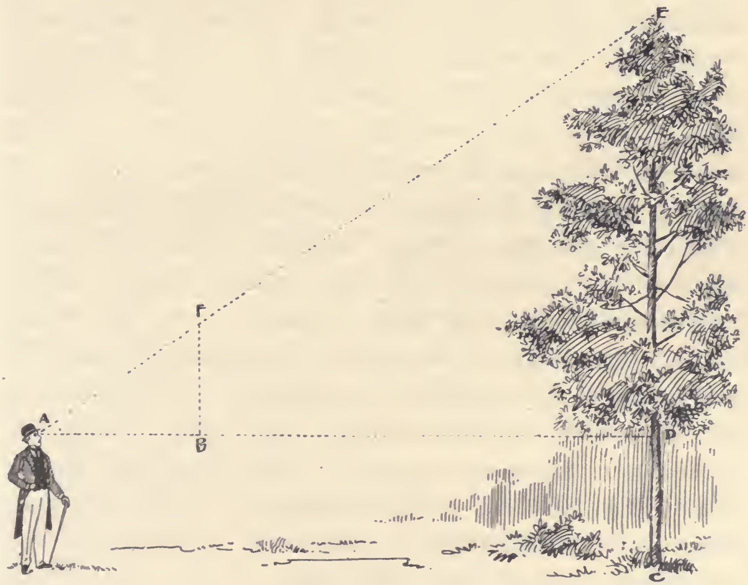
In Algiers the very considerable tree planting under the French Forest officers, notably "Cordier,'' has been largely of Eucalyptus. This is also the case in the Argentine plantations. In fact where the Eucalyptus will grow there is no tree to compare with it in cheapness of handling and rapidity of growth. Besides these advantages trees of this genus are generally resistent to all forms of insect pests, more so indeed in foreign lands than in their own native haunts. Eucalyptus amygdalina variety angustifolia is often subject in California to willow scale. This scale is sometimes found on the fruits of other species but not on the trees themselves. Where the temperature is not too cold the Eucalyptus will always be the most popular and the most advantageous tree for grove or forest plantings.

HOW TO MEASURE THE HEIGHT OF A TREE.

Start from the trunk of the tree at a point about as high as the eye of the observer and measure out a distance according to convenience, which should preferably be greater than the supposed height of the tree. At this point a stake should be set, the top of which must be at the same elevation from the ground as the point on the

tree from which the measure was made. Then at about a quarter of the distance between the stake and the tree a pole must be raised until its top comes into the line between the stake and the top of the tree. This can be seen, of course, by the observer looking over the top of the stake.

The accompanying diagram explains the rest.



To calculate the height of a tree, A B : B F = A D : D E.
Suppose A B = 10 feet, B F = 8 feet and A D = 100 feet,
then 10 : 8 = 100 = D E.
Hence D E = 80 feet and the height of the tree = 80 -- D C the height of the man from the ground.

THE EUCALYPTUS BOTANICALLY.

The Eucalypti have been classified in various ways, viz., by the leaves, by the barks, by the kino-gums, by the anthers and in a composite way by Bentham. The anthereal system seems to me to be the best for the general student; I have therefore adopted it. By means of the editing done by Prof. A. J. McClatchie, the plate of typical anthers of each series, the key and the glossary, moderate attention will enable a person of intelligence to identify the leading species of the genus. I have described three species which are growing at Santa Monica. Some of the specimens of Eucalyptus sent to Von Mueller arrived in bad condition. Of the three species named by me the Baron thought one might be a form of Eucalyptus globulus, and another he called Eucalyptus occidentalis. A reference to the chapter on Eucalyptus oil will show that it would be justifiable to found new species on these trees from the oils alone. The oils are widely different in both yield and character from Eucalyptus globulus in the one case and Eucalyptus occidentalis in the other.

The genus is spoken of by all observers as an extremely difficult one botanically. The difficulty lies in the strong tendency to vary in the species and of a consequent merging of species into each other. The present arrangement of species is far from being satisfactory. The trees which we now call Eucalyptus amygdalina var. angustifolia and var. regnans are surely worthy of specific rank. This would give us three species and three varieties out of the

present amygdalina in California. Leucoxylon and sideroxylon I have accepted as separate species. The variety pallida of sideroxylon is almost worthy of specific rank. Eucalyptus viminalis has a considerable range of variation here and one of these forms is persistent and specific.

Baron Von Mueller writes me that the specimen of our Eucalyptus robusta sent him is robusta. Yet it is very different in its bud form from the plate of this species in the Eucalyptographia. What I have called Eucalyptus Californica is by Von Mueller called occidentalis. It is quite different in bark, flowers, fruits and foliage from the typical occidentalis and has varieties of its own. I have never seen a typical Eucalyptus maculata. We have only the variety citriodora, but I think that this tree as well as the lemon-scented ironbark are separate species; many other similar instances exist in the genus. In a general way I believe that a considerable number of additional species should be recognized in the Eucalyptus.

This work of complete classification could best be done in Australia where the old trees could be often definitively placed by their seedlings alone.

The beautiful botanical garden at Sydney or the very interesting one at Melbourne would make good seedling headquarters. Such local work supplemented by experiments in the widely distributed stations under Mr. Walter Gill in South Australia together with examination and comparison of mature forms, would soon clear up the confusion that now troubles us. The classification of Bentham is added as an aid to students and I have also put in those descriptions of his which are not clearly synonyms of those in the regular system. Thus where a specimen of Eucalyptus can not be run out on the key and anthrial

classification it may still be looked for in Bentham's system and descriptions. The following partial list of synonyms and varieties, together with the native habitat and range and vernacular names of the species may help somewhat in identifications.

SYSTEMATIC POSITION AND CLASSIFICATION OF THE EUCALYPTI.

The Eucalypti belong to the order *Myrtaceæ*, which is characterized as follows:

Trees or shrubs; leaves opposite or alternate, usually dotted; flowers regular or nearly so. Calyx-tube grown to the ovary at the base or up to the insertion of the stamens. Petals usually as many as calyx-lobes, very much imbricate in the bud, the external one sometimes larger than the others, but usually all nearly equal when expanded, sometimes all concrete and falling off in a single operculum, or rarely entirely wanting. Stamens indefinite, usually numerous, inserted in one or several rows on a disk; filaments free or rarely united into a ring or tube at the base, or into as many bundles as there are calyx-lobes; anthers 2-celled, versatile or attached by the base, the cells opening in longitudinal slits, or rarely in terminal pores. Ovary enclosed in the calyx-tube, sometimes 1-celled, with a placenta attached to the base or adnate to one side, more frequently 2 or more celled, with the placentas in the inner angle of each cell, very rarely 1-celled with 2 purietal placentas. Style simple, with a small, capitate, peltate, or lobed stigma. Ovules 2 or more to each placenta, in 2 or more rows, or very rarely solitary. Fruit adnate to the calyx-tube, capsular and opening at the summit in as many valves as cells, or indihescent, dry, and 1-seeded, or succulent and indihescent. Perfect seeds usually very few or solitary in each cell, even when the ovules are numerous, or rarely numerous and perfect.

The order is divided into four tribes, the Eucalypti falling into the tribe Leptospermæ (meaning "small seeds"), the chief characteristic of which is its 2 to 5-celled ovary opening at the summit by as many valves as there are cells. Of the genera belonging to this tribe, the genus Eucalyptus is by far the largest, about 150 species being known.

CHARACTERISTICS OF THE GENUS EUCALYPTUS L'HERITIER.

Calyx of firm consistence, separated into a lower persistent portion and a deciduous lid. Petals, none, unless represented in some few species by an inner membrane. Stamens very numerous, inserted close to the edge of the calyx-tube in several rows, all fertile or some of the

outer by absence of anthers sterile, always finally deciduous; filaments thread-like, pointed, inflexed while in bud or the outer or very seldom all filaments straight before expansion; anthers dorsified, their two cells parallel or divergent, each opening by a marginal or anterior slit or less commonly by a pore; pollen-grains tetrahedrous, smooth, with longitudinal apertures. Style long; stigma convex or almost flat, undivided, seldom much dilated beyond the summit of the style. Ovary 2-6-celled, its lower portion grown to the calyx, its upper portion more or less free. Ovules in each cell numerous, the greatest majority remaining unfertilized. Cotyledons broad, much compressed, somewhat folded, undivided or bi-lobed, curved around the cylindrical straight erect radicle.

Evergreen trees, scattered as well as gregarious, sometimes of enormous height, or dwarfed shrubs, present in all parts of Australia even in intratropic low lands or in arid desert sands or on alpine elevations, more scantily occurring in New Guinea, in Timor, and very rarely in the Moluccas, mostly of rapid growth, flowering occasionally at a very early age; stem often kinofluous; bark either completely persistent or its outer layers deciduous; matured wood always particularly hard; main branches usually distant; foliage often not dense; branches frequently pendent, quite glabrous, or sometimes those of young plants (and even mature ones) rough-hairy; leaves of aged plants nearly always glabrous and thick in texture, never soft-hairy, often scattered and conspicuously stalked or in some species opposite and then generally sessile, sometimes united; those of young plants frequently different in texture, position and shape from those of the more aged plants; these latter generally approaching in form to lanceolar-sickle-shaped, often of equal color and turning one edge toward the zenith and the other toward the ground; much less frequently considerably darker above, and spreading horizontally; oil-dots pellucid or concealed; peculiarly and strongly odorous; primary veins often copious and much spreading; inflorescence either axillary or terminal or more rarely both modes united; flowers in single or paniculated umbels, rarely in twos, or solitary; umbel-stalks and flower-stalklets commonly present, the former sometimes much dilated; umbels while very young enclosed within a pair of fugacious and sometimes diminutive bracts; calyces of different species very variable in size; lid not rarely provided with a minute early dropping accessory outer layer; filaments gnerally pale with a slightly yellowish tinge, more rarely bright yellow, orange-colored or crimson; inner filaments gradually shorter; connective of anthers usually raised at the summit or dorsally towards the top into a callous gland; slits of anthers sometimes confluent; fruits for a long while persistent, from very small in some species to remarkably large in others, oftener smooth than streaked or ridged; valves always glabrous, very rarely by the persistent base of the style permanently connected; seeds long retained in the fixed fruit, soon

shedding on detachment of the latter; fertile seeds usually outside, dark brown; sterile seeds mostly pale brown and smaller than the others.

To classify the species of so large a genus is no easy task. The system of classification adopted below is based on the structure of the anthers, the position of the valves, the shape of the lid, the style of inflorescence, and the similarity or dissimilarity of the two leaf surfaces. The first thing to ascertain about a Eucalyptus that one wishes to identify is the structure of the anthers. This can usually be done with a good lens by examining anthers from buds just ready to open. It is hoped that the accompanying plate and artificial key preceding each section of the genus will aid in the work of identification. In using the key to a section, the first thing to ascertain is whether the valves of a mature seed vessel are enclosed within it or project partly or wholly from the mouth.

I. RENANTHEREAE.

Anthers mostly broader than long, usually kidney-shaped, opening anteriorily by divergent, upward confluent slits. (Umbels generally solitary. Fertile and sterile seeds mostly of the same shape.)

ARTIFICIAL KEY.

A. Valves completely enclosed—B.
A. Valves partly exserted—C.
A. Valves completely exserted—1–3.
  B. Lid hemispheric—4–11.
  B. Lid not hemispheric—D.
  C. Lid hemispheric—E.
  C. Lid not hemispheric—12–13.
    D. Leaves equally green—14–15.
    D. Leaves unequally green—16–17.
    E. Leaves equally green—18–19.
    E. Leaves unequally green—20–21.

1. **E. Santalifolia, F. M.** Dwarf; leaves thick, rather narrow, equally green, shining; umbels solitary, stalklets almost none, lid semi-ovate-conical; outer stamens straight in bud, anthers roundish-cordate; fruits hemispheric below, border broad, convex, emersed, valves very short, exserted.

2. **E. Capitellata, Sm.** Leaves thick, elongated, rather less shining beneath, very inequilateral at the base; umbels axillary, stalklets none, lid hemispheric; fruits semiovate below, border broad, convex, emersed, valves much exserted.

3. **E. Macrorrhyncha, F. M.** Leaves elongated, equally green; umbels solitary; calyx-lid concavely attenuated, sharply pointed; fruits below hemispheric, border convex, emersed, valves much exserted.

4. **E. pauciflora, Sieb.** Leaves elongated, thick, shining, equally green, veined longitudinally; umbels solitary, lid hemispheric; fruits truncate-ovate, border of orifice depressed, valves enclosed.

5. **E. amygdalina, Lab.** Leaves thin, equally green; veins not much spreading, oil-dots copious, transparent; umbels solitary, flowers small, lid almost hemispheric; fruits truncate-ovate, border depressed, valves enclosed.

E. amygdalina regnans. *Var. 1.* Lid hemispheric, pointed, fruit obscurely speckled and cut off flat on top as though shaved, fruit and flowers small; bark persistent, rough; foliage light green; leaves thin.

Var. 2. Lid hemispheric, pointed; fruit scarcely speckled; valves in slight depression; top of fruit not flat and uniform; fruit and flowers much larger than above; bark smooth, decorticates; foliage dull green.

Var. 3. Lid hemispheric, pointed; flowers and fruit larger; bark smooth, decorticates; foliage bluish green, often with bluish bloom.

Var. 4. Leaves narrow; lid hemispheric, flat—no point—purple or red spot on center of lid; fruit regularly speckled, valves in well defined, slight depression; fruit and flowers between the two sizes; bark apparently persistent and similar to that of what we identify as Eucalyptus punctata, somewhat suggestive of bark of Eucalyptus tereticornis; foliage dull, dark green and leaves very narrow.

Var. 5. Similar to above except fruits and flowers smaller and grows like bush.

Var. 6. Similar, except bark smooth, decorticates; large tree; peppermint odor present in all—far strongest in regnans.

Leaves in last three very narrow, dull, deep green, thickish and generally slimy on both sides.

E. ligustrina, DC. Prod. iii. 219, described from Sieber's specimens n. 617, which I have not seen, is probably this species.

Var. radiata. Leaves rather broader, 3 to 4 in. long. Flowers usually more numerous, sometimes near 20 in the umbels. Fruit almost pear-shaped.—*E. radiata*, Sieb. in DC. Prod. iii. 218; DC. Mem. Myrt. t. 7.—Chiefly in N. S. Wales, *Sieber, n.* 475, and others; Bent's Basin and Nepean rivers, "White Gum," with a smooth bark, *Woolls;* South of Argyle, *A. Cunningham*, but also in Victoria and Tasmania passing into the ordinary form.

Var. nitida. Leaves broader and more rigid. Peduncles and pedicels shorter. Flowers rather longer.—*E. ambigua*, DC. Prod. iii. 219? from the diagnosis taken from Labillardière's specimen. *E. nitida.* Hook. f. Fl. Tasm. i. 137. t. 29.—In the dried specimens this variety appears to pass into the variety *elata* of *E. Risdoni.*

Var.? Hypericifolia. Leaves of the fruiting branches all opposite, oblong-lauceolate, rounded or cordate at the base, and sessile or nearly so.—Risdon Cove, *R. Brown.*—*E. Hypericifolia*, R. Br. Herb.—The specimens are large and good but in fruit only. To this form may belong also some of the garden plants described from the foliage only under the same name.

NOTES ON SYNONYMS AND VARIETIES.

Names have in many cases been given, first to one species, then to another, or to varieties by the same, or usually by different botanists. This common source of botanical confusion, requires guarding against in the Eucalyptus. By referring to a list that follows help may be obtained in correcting name errors and in placing varieties correctly.

Eucalyptus coriacea, see Eucalyptus pauciflora. Eucalyptus Virgata, see Eucalyptus Sieberiana.

6. **E. Risdoni, Hook.** Leaves sometimes all, even on the flowering branches, opposite ovate-cordate and more or less connate, or sometimes those of the flowering branches alternate, broadly lanceolate and falcate, rather thick with oblique veins scarcely conspicuous, the intramarginal one at a distance from the edge. Peduncles axillary or lateral, terete or angular, bearing each an umbel of 4 to 8, or even more. Flowers larger than those of Eucalyptus amygdalina. Fruit subglobose truncate. The rim rather broad, flat, the valves enclosed.

7. **E. obliqua, L'Her.** Leaves equally green, shining, very inequilateral at the base; umbels solitary, calyces granular-rough, lid hemispheric; fruits truncate-ovate, border compressed, valves enclosed,

8. **E. hæmastoma, D. C.** Leaves equally green, very shining; umbels solitary, stalks somewhat compressed; outer stamens sterile; fruits semiovate, border depressed, valves very short, enclosed.

9. **E. Todtiana, F. M.** Leaves thick, shining, almost equally green; umbels solitary, stalklets none, lid hemispheric; anthers cordate; fruits rather large, truncate--globular, valves enclosed; fertile seeds membranously margined.

10. **E. euprestium, F. M.** Leaves rather small, equally green; umbels mostly solitary; flowers small, lid hemispheric; fruits large, truncate-globular, greyish, border compressed, valves enclosed; fertile seeds membranously margined.

11. **E. sepulcralis, F. M.** Leaves narrow, equally green; umbels solitary; stalks elongated; lid hemispheric, filaments yellow, anthers roundish; fruits large, ovate — urnshaped, narrowed upwards, valves deeply enclosed.

12. **E. Oldfieldii, F. M.** Dwarf; leaves equally green, thick; umbels solitary, stalks short, stalklets very short, lid semiovate-hemispheric, border of orifice broad convex, emersed, valves exserted.

13. **E. marginata, Sm.** Leaves paler beneath, veins spreading;

umbels solitary, lid conical; outer stamens straight in bud; fruits globular-ovate, truncate, border compressed, valves very short, barely enclosed.

14. **E. stellulata, Sieb.** Leaves small, thick, equally green, veined longitudinally; umbels solitary, flowers very small, numerous, lid semiovate-conical; fruits truncate globular, border depressed, valves enclosed.

15. **E. eugenioides, Sieb.** Leaves equally dark green, shining, very inequilateral at the base, much transparently dotted; umbels mostly solitary, lid semiovate; fruits truncate-globular, border depressed, valves barely enclosed.

16. **E. piperita, Sm.** Leaves less shining beneath, much transparently dotted; umbels solitary, lid semiovate-conical; fruits truncate-ovate, border compressed, valves enclosed.

17. **E. Pilularis, D. C.** Leaves rather less shining beneath; umbels mostly axillary, their stalks compressed, lid semiovate-conical; fruits truncate-ovate, border depressed, valved enclosed.

18. **E. Sieberiana, F. M.** Leaves elongated, thick, pale, equally green, shining; veins thin, not much spreading; umbels solitary, their stalks compressed, lid hemispheric; outer stamens sterile; fruits truncate-ovate, border depressed, valves very short, barely enclosed.

19. **E. Baileyana, F. M.** Leaves thin, equally green, much transparently dotted; umbels mostly solitary; lid hemispheric; fruits globular-urnshaped, border compressed, valves barely enclosed.

20. **E. acmenoides, Sch.** Leaves paler beneath; umbels mostly axillary, their stalks slender, lid hemispheric, pointed; fruits truncate-ovate, border compressed, valves barely enclosed.

21. **E. microcorys, F. M.** Leaves thin, much paler beneath, much transparently dotted, veins spreading; umbels partly paniculated, stalklets elongated, lid very small, hemispheric; outer stamens sterile; fruits hemiellipsoid, border compressed, valves minute, barely enclosed.

II. PORANTHEREAE.

Anthers not or hardly broader than long, usually roundish, opening by pores.

ARTIFICIAL KEY.

Valves barely enclosed—1–2.
Valves completely enclosed—3–9.
Valves deeply enclosed—10–12.

1. **E. uncinata, Turcz.** Dwarf; leaves narrow, equally green; umbels solitary; flowers small; lid semiovate; stamens sharply inflexed before expansion; fruits semiovate, border depressed, valves pointed barely enclosed.

2. **E. populifolia, Hook.** Leaves broad, equally green, shining, long-stalked, much transparently dotted; stalklets very short; umbels paniculated; lid hemispheric; fruit small, semiovate, border rather depressed, valves close to the summit, barely enclosed.

3. **E. paniculata, Sm.** Leaves rather thin, paler beneath, umbels mostly paniculated; lid thin, conical-semiovate; outer stamens sterile; anthers truncated, opening at the summit; stigma much dilated; fruit semiovate, border of orifice compressed, valves enclosed.

4. **E. leucoxylon, F. M.** Leaves equally dull green; umbels solitary, mostly three-flowered, stalklets elongated, lid semiovate pointed; outer stamens sterile, anthers truncated, opening at the summit; stigma much dilated; fruits semiovate, border compressed, valves closed.

5. **E. melliodora, A. Cunn.** Leaves equally dull green; umbels solitary; flowers small; lid conic-hemispherical; outer stamens sterile; anthers truncated, opening at the summit; stigma much dilated; fruits truncate-ovate; border compressed, valves enclosed.

6. **E. polyanthema, Sch.** Leaves broad, equally dull green; umbels paniculated; lid almost hemispheric; outer stamens sterile; anthers truncated, opening at the summit; fruit truncate-ovate, border compressed, valves enclosed.

7. **E. gracilis, F. M.** Dwarf: leaves narrow, equally green, shining; umbels solitary; calyces angular; lid almost hemispheric; outer stamens sterile; fruits hemiellipsoid, border compressed, valves enclosed.

8. **E. largiflorens, F. M.** Leaves thin, equally dull green; umbels paniculated; lid double, the inner hemispheric, less wide than the calyx-tube; outer stamens sometimes sterile; fruit small; lid hemispheric; fruit truncate-ovate, border rather compressed, valves enclosed.

9. **E. Behriana, F. M.** Leaves thick, broadish shining, equally green, umbels paniculated; flowers small; lid hemispheric; fruit truncate-ovate, border rather depressed, valves enclosed.

10 **E. ochrophloia.** Leaves elongated, equally green, shining, veins not much spreading; umbels partly paniculated; calyces angular; lid semiovate-conical, pointed; outer stamens sterile; fruit hemiellopsoid; border compressed, valves deeply enclosed.

11. **E. odorata, Behr.** Leaves rather narrow, equally green; oil-dots numerous; umbels mostly solitary; lid hemispheric-conical; anthers truncated; stigma somewhat dilated; fruits hemiellipsoid, border compressed, angular at the edge, valves deeply enclosed.

12. **E. hemiphloia, F. M.** Leaves thick, elongated, equally green; umbels paniculated; calyces somewhat angular; lid semiovate-conical; fruit hemiellopsoid, border compressed, valves enclosed.

III. STRONGYLANTHEREAE.

Anthers not, or scarcely longer than broad, usually roundish, opening by longitudinal slits.

ARTIFICIAL KEY.

A. Valves completely enclosed—B.
A. Valves partly exserted—C.
A. Valves completely exserted—D.
B. Umbels solitary—E.
B. Umbels paniculated—1–6.
C. Umbels solitary—7–9.
C. Umbels paniculated—10, 11.
D. Umbels solitary—12–14.
D. Umbels paniculated—15, 16.
E. Leaves equally green—17–19.
E. Leaves unequally green—20–22.

E. gamophylla, F. M. Dwarf; leaves mostly opposite, connate, broad, equally dull-green or ash-grey; umbels partly paniculated; lid patellar; fruits truncate-ellipsoid, border compressed; fertile seeds membranous-margined.

2. **E. pruinosa, Sch.** Leaves opposite, sessile, broad, blunt, equally ash-grey; umbels terminal, paniculated; lid hemispheric, pointed; slits of anthers short; fruits hemiellipsoid, border compressed, valves barely enclosed.

3. **melanophloia, F. M.** Leaves opposite, sessile, broad, equally ash-grey; umbels partly paniculated; lid semiovate-conical; fruits small, semiovate, somewhat angular, border compressed, valves barely enclosed.

4. **E. drepanophylla, F. M.** Leaves elongated, equally dull-green; umbels mostly paniculated; lid semiovate, blunt; fruits semiovate, angular, border compressed, valves barely enclosed.

5. **E. brachyandra, F. M.** Dwarf; leaves broadish, blunt; umbels paniculated; flowers very small; stamens extremely short; fruits minute, bellshaped-semiovate, border compressed, valves enclosed.

6. **E. Howittiana, F. M.** Leaves much paler beneath; umbels paniculated; stalklets none; flowers very small; lid conical, acute, pale; fruits minute, truncate-globular, border compressed, valves enclosed.

7. **E. oleosa, F. M.** Dwarf; leaves equally light-green; umbels solitary; stalks slender, stalklets very short; lid semiovate-conical, point-

ed; fruits truncate-ovate, neither large nor streaked, border compressed, valves long-pointed, half exserted.

8. **E. cneorifolio, D.C.** Leaves very narrow, thick, equally green; umbels solitary, stalks short, stalklets none; lid semi-ovate; fruits small, semiovate, border depressed, valves slightly exserted.

9. **E. salmonophloia, F. M.** Leaves equally green, shining; oil-dots copious; umbels solitary; stalks slender, stalklets short; lid semi-ovate-conical; outer stamens straight in bud; fruit small, semiovate, border compressed, valves long-pointed, much exserted.

10. **E. crebra, F. M.** Leaves narrow, thin, equally dull-green, veins spreading; umbels mostly paniculated; flowers small; lid semiovate-conical; stigma dilated; fruits small, semiovate, border compressed, valves short, somewhat exserted.

11. **E. siderophloia, Benth.** Leaves elongated, equally green; umbels partly paniculated; lid conical, very acute; outer stamens straight in bud; fruits samiovate, border compressed, valves somewhat exserted.

12. **E. alba, Rein.** Leaves broadish, equally dull-green or ash-grey; umbels solitary; lid semiglobular, short pointed; fruit topshaped-hemispheric, border depressed, valves exserted.

13. **E. platyphylla, F. M.** Leaves often large, cordate or ovate roundish, long-stalked, equally dull-green; umbels solitary; stalks short, stalklets almost none; lid blunt; fruits small, semiovate, border depressed, valves exserted.

14. **E. decipiens, End.** Leaves equally dull-green; umbels solitary; stalklets none; lid broad-conical; fruit semiglobular, border depressed, broadish, valves long-pointed, much exserted.

15. **E. Raveretiana, F. M.** Leaves thin, somewhat paler beneath; oil-dots pellucid; umbels paniculated; lid conical, acute; fruits minute, semiglobular beneath, border compressed, valves much exserted.

16. **E. microtheca, F. M.** Leaves equally dull, and pale-green; umbels paniculated; lid semiovate; fruits small, semiglobular beneath, border compressed, valves much exserted.

17. **E. doratoxylon, F. M.** Leaves opposite, stalked, narrow acute; umbels solitary, bent downward; lid much pointed; fruit ovate-globular, orifice small, border compressed, valves enclosed.

18. **E. incrassata, Lab.** Dwarf; leaves thick, equally light green, shining; umbels solitary; stalks broadly compressed, stalklets almost none; lid nearly hemispheric, pointed or blunt; fruits truncate-ovate, streaked, border compressed, valves acute, enclosed.

19. **E. patens, Benth.** Leaves thin, elongated, almost equally dull-green; umbels mostly axillary; lid nearly hemispheric; fruits truncate-ovate, somewhat streaked, border compressed, valves enclosed.

20. **E. Planchoniana, F. M.** Leaves elongated, shining, slightly paler beneath; umbels solitary; stalks broadly compressed, stalklets short;

lid broadish-conical, acute; outer stamens straight in bud; fruits rather large, semiovate, streaked, border compressed, valves enclosed.

21. **E. diversicolor, F. M.** Leaves elongated, much paler beneath; umbels solitary; lid nearly hemispheric; fruits truncate-ovate, attenuated at the base, border compressed, valves enclosed.

22. **E. phoenicea, F. M.** Leaves thin, dull-green; umbels solitary, many-flowered; lid nearly hemispheric; filaments scarlet; ovary two-celled; fruits urnshaped-ellipsoid, border compressed, valves deeply enclosed.

IV. ORTHANTHEREAE.

Anthers distinctly longer than broad, from ovate to narrow-oblong, opening by almost parallel slits.

ARTIFICIAL KEY.

A. Valves completely enclosed—B.
A. Valves partly exserted—E.
A. Valves completely exserted—F.
 B. Umbel solitary—C.
 B. Umbel paniculated—D.
  C. Leaves equally green—1–14.
  C. Leaves unequally green—15–18–35.
  D. Leaves equally green—19–28.
  D. Leaves unequally green—29–35.
  E. Leaves equally green—36–45.
  E. Leaves unequally green—46.
  F. Leaves equally green—47–57.
  F. Leaves unequally green—58–59.

1. **E. cordata, Lab.** Leaves opposite, sessile, mostly cordate, crenulated, equally dull green; oil-glands pellucid; umbels solitary; stalklets none; fruits semiovate, border compressed, at the edge annular, valves barely enclosed.

2. **E. urnigera, Hook.** Leaves scattered, long-stalked, almost lanceolar, crenulated, equally dark green; oil-glands pellucid; umbels solitary; stalks elongated, stalklets rather short; fruits ellipsoid-urn-shaped, border compressed, at the edge annular, valves deeply enclosed.

3. **E. redunca, Sch.** Leaves equally green; umbels solitary; stalks broadly compressed, lid conical, acute; fruit hemiellipsoid, border compressed, valves barely enclosed.

4. **E. foecunda, Sch.** Leaves narrow, equally green; umbels

mostly solitary; stalks lender; lid hemispheric; fruit hemiellipsoid, border compressed, valves deeply enclosed.

5. **E. goniocalyx, F. M.** Leaves equally green; umbels solitary, stalk compressed, stalklets very short; lid pyramidal-hemispheric; fruit truncate-ovate, angular, border narrow, depressed; valves barely enclosed.

5½. **E. McClatchie, Kinney.** Leaves long-stalked, scattered, lanceolar or sickle-shaped, rather narrow, equally dull green; umbels solitary, axillary; stalk compressed, about as long as calyx tube, stalklets short; calyx tube truncate with two edges and tendency to be somewhat flattened or a little out of a true circle; buds very angular, ridges showing almost as wings; lid hemispheric, acuminate, central point of lid blunt and prominent, valves enclosed, bark sheds in long strips; general appearance of tree suggests Eucalyptus globulus or Eucalyptus goniocalyx; anthers oblong, dorsal gland prominent; stamens all fertile, inflexed in bud; stigma not or scarcely broader than style.

6. **E. pachypoda, F. M.** Dwarf; leaves thick, equally green; umbels solitary; stalks thick, very short; stalklets none; lid semiovate; fruit hemielliopsoid, somewhat angular, border compressed, valves enclosed.

7. **E longifolia, Lind.** Leaves elongated, equally green; umbels solitary; stalklets elongated; calyces pale. lid broad-conical, acute; fruit rather large, bellshaped-semiovate, angular, border ascendant, valves enclosed.

8. **E. Preissiana, Sch.** Dwarf; leaves very thick, broadish, blunt, equally green, often opposite; umbels solitary; stalk broadly compressed, stalklets none; lid nearly hemispheric; filaments yellow; fruit large, top-shaped-semiovate, border very broad, depressed, valves enclosed, blunt, convergent.

9. **E. tetraptera, Turc.** Dwarf; leaves very thick, equally green, shining; flowers solitary, stalk broadly compressed, bent downward; stalklets none; calyx-tube quadrangular, slightly 4-toothed, broader than the pyramidal lid; filaments red, anthers purplish; fruit very large, bell-shaped-quadrangular, border depressed, valves enclosed.

10. **E. tetradonta, F. M.** Leaves opposite, elongated, equally dull-green; umbels solitary, stalklets very short; calyx-tube conspicuously 4-toothed, lid hemispheric, discal expansion raised; fruit bell-shaped-semiovate, angular, border compressed, valves enclosed.

11. **E. odontocarpa, F. M.** Dwarf; leaves mostly opposite, very narrow, equally green; umbels solitary; stalklets very short; calyx-tube 4-toothed, lid patellar; fruit small, hemiellopsoid, border compressed, valves enclosed.

12. **E. eudesmioides, F. M.** Dwarf; leaves opposite or scattered, rather narrow, equally green; umbels solitary; stalk slender, stalklets very short; calyx-tube almost toothless; lid patellar; stamens forming

four bundles; fruit truncate-ovate, border compressed, valves enclosed; seeds membranously margined.

13. **E. tetragona, F. M.** Dwarf; leaves thick, opposite, broad, equally whitish-grey; umbels solitary; stalk compressed; calyx-tube slightly 4-toothed; lid patellar; stamens forming four bundles; fruit rather large, truncate-ovate, angular, border compressed, valves enclosed; seeds much membranously margined.

14. **E. erythrocorys, F. M.** Dwarf; leaves thick, elongated, mostly opposite, equally green; umbels solitary or flowers single; stalk compressed, stalklets none; calyx-tube quadrangular, slightly 4-toothed; lid depressed, red; stamens forming four bundles, filaments yellow; fruit very large, bellshaped-hemispheric, border very broad, somewhat ascendant, valves barely enclosed.

15. **E. miniata, A. Cunn.** Leaves dull green, slightly paler beneath; veins feathery-spreading; umbels usually solitary; stalklets almost none; lid conic-hemispheric; filaments crimson; fruits very large, urnshaped-ovate, bluntly ridged, border compressed, valves enclosed.

16. **E. corynocalyx, F. M.** Leaves shining, somewhat paler beneath; umbels mostly solitary; lid almost hemispheric, slightly overreaching the orifice of the calyx: fruits urnshaped-ellipsoid, streaked, border compressed, valves enclosed.

17. **E. botryoides, Sm.** Leaves much paler beneath; veins feathery-spreading; umbels solitary; stalk broadly compressed, salklets almost none; lid hemispheric; fruit hemiellipsoid, border compressed, valves barely enclosed.

18. **E. robusta, Sm.** Leaves thick, broadish, somewhat paler beneath; umbels solitary, stalk broadly compressed; calyces pale, lid semiglobular-conical, broader than the calyx-tube; fruit truncate-ovate, border compressed, valves coherent, barely enclosed.

Local robusta has conical lid not broader than calyx tube.

19. **E. Foelscheana, F. M.** Dwarf; leaves large, very broad, thick. greyish-green, hardly paler beneath; flowers paniculated; stalklets upward thickened; lid patellar, tearing off along an irregular suture, not so wide as the tube of the calyx; fruits large, smooth, ovate-urnshaped, border compressed, valves enclosed; fertile seeds large, terminating in a long membrane.

20. **E. latifolia, F. M.** Leaves long-stalked, broad, equally green; umbels paniculated; stalklets slender; fruit rather small, semiovate, somewhat bell-shaped, border compressed, valves enclosed; fertile seeds terminating in a membrane.

21. **E. terminalis, F. M.** Leaves thick, dull green, hardly paler beneath; umbels paniculated; stalklets elongated; lid tearing off along an irregular suture; fruits somewhat large, smooth, urnshaped-ovate,

border compressed, valves enclosed; fertile seeds terminating in a long membrane.

22. E. clavigera, A. Cunn. Branchlets hairy-rough; leaves partly opposite, broad, equally greyish-green; umbels paniculated; stalklets thin, much elongated; lid patellar, shining; fruits hemiellipsoid-urnshaped, border compressed, valves enclosed.

23. E. tessellaris, F. M. Leaves narrow, elongated, equally green; umbels mostly paniculated; stalklets very short; lid patellar, shining; fruits truncate-ovate, slightly urceolar, border compressed, valves enclosed; fertile seeds almost flat, membranous-margined.

24. E. maculata, Hook. Leaves elongated, equally green; veins feathery-spreading; umbels paniculated; stalklets short; lid double, hemispheric, the inner thin, shining; fruit truncate-ovate, somewhat urnshaped, border compressed, valves enclosed.

25. E. eximia, Sch. Leaves thick, elongated, equally green; umbels paniculated; stalklets none; lid thin, hemispheric, shining, imperfectly double; fruit rather large, truncate ovate, somewhat urnshaped, border compressed, valves enclosed; fertile seeds large.

26. E. Watsoniana, F. M. Leaves broadish, equally green; umbels paniculated; lid thick, depressed-hemispheric, wider than the calyx-tube, shining; fruits large, urnshaped-semiovate, border broad, descendingly depressed, raised above the calyx-tube, valves enclosed; fertile seeds large.

27. E. peltata, Benth. Branchlets hairy-rough; leaves broadish, mostly inserted above their base, equally pale-green; umbels paniculated; stalklets very short; lid double, almost hemispheric, the inner shining; fruits rather small, truncate-ovate, somewhat urnshaped, border compressed, valves enclosed.

28. E. setosa, Sch. Leaves opposite, broad, sessile, equally dull- and pale-green; umbels mostly paniculated, as well as the branchlets bristly-rough; stalklets elongated; lid tearing off along an irregular suture, not so wide as the calyx-tube; fruits large, truncate-ovate, somewhat urnshaped, smooth, border compressed, valves enclosed; fertile seeds terminating in a long membrane.

29. E. ptychocarpa, F. M. Leaves large, broadish, acute, much paler beneath; veins feathery-spreading; umbels paniculated; stalklets elongated; lid hemispheric; filaments crimson; fruits very large, truncate-ellipsoid, prominently ridged, border compressed, valves enclosed; fertile seeds terminating in a long membrane.

30. E. ficifolia, F. M. Leaves broadish, much paler beneath; veins feathery-spreading; umbels paniculated; stalklets elongated; lid patellar, less wide than the calyx-tube, tearing off along an irregular suture; filaments crimson; fruits large, smooth, urnshaped-ovate, border compressed valves enclosed; fertile seeds pale, terminating in a long membrane.

31. **E. calophylla, R. Br.** Leaves broad, acute, much paler beneath; veins feather-spreading; umbels paniculated; stalklets elongated; lid patellar, less wide than the calyx-tube, tearing off along an irregular suture; fruits large, smooth, ovate-urnshaped; border compressed, valves enclosed; fertile seeds terminating in a large membrane.

32. **E. Abergiana, F. M.** Leaves thick, broadish, acute, much paler beneath ; veins feathery-spreading ; umbels paniculated ; stalklets almost none ; lid hemispheric, tearing off along an irregular suture ; fruits large, smooth, ovate-urnshaped, border compressed, valves enclosed; fertile seeds terminating in a large membrane.

33. **E. corymbosa, Sm.** Leaves much paler beneath; veins feathery-spreading; umbels paniculated; stalklets elongated; lid short, tearing off along an irregular suture; fruits rather large, smooth, ovate-shaped, border compressed, valves enclosed; fertile seeds terminating in a very short membrane.

34. **trachyphloia, F M.** Leaves rather narrow, elongated, slightly paler beneath; umbels paniculated; lid very small, patellar, tearing off along an irregular suture; fruits rather small, urnshaped-ovate, border compressed, valves enclosed.

35. **E. punctata, D. C.** Leaves paler beneath; veins very spreading, oil-dots pellucid; umbels partly paniculated; stalks broadly compressed; lid semiovate-conical; fruit semiovate, border depressed, valves small, barely exserted.

36. **E. pulverulenta, Sims.** Leaves opposite, sessile, mostly cordate, equally whitish-grey; oil-glands pellucid; umbels solitary, three-or few-flowered; stalklets almost none; fruits small, semiovate-topshaped; border narrow, depressed, valves small, exserted.

37. **E. Gunnii, Hook.** Leaves scattered, stalked, thick, broadish-lanceolar, equally dark green, shining; umbels solitary, with several flowers; stalklets vory short; lid shining. hemispheric, short-pointed; fruits topshaped-semiovate, border depressed, valves small, slightly exserted.

38. **E. salubris, F. M.** Leaves thin, equally dark-green; oil-dots copious, pellucid; umbels solitary, stalks compressed ; lid hemiellipsoid; fruits semiovate, border depressed, very narrow, valves small, exserted.

39. **E. occidentalis, End.** Leaves thick, equally green; umbels solitary; stalks broadly compressed, stalklets short; lid cylindric-conical, stamens straight in bud; fruits bellshaped-semiovate, border depressed, valves exserted, pointed.

39½. **E. Californica, Kinney** Leaves thick, shining on both sides, dark green, often irregular, one-sided or crenulated in form; umbels solitary; stalks very broadly compressed, bent; stalklets well defined; lid cylindrical-conical, narrower than tube of calyx; stamens straight in bud, yellow, greenish-yellow or crimson; fruits truncate, somewhat ridged, valves barely enclosed, generally coherent, bark sheds. Fruit, flowers and stems larger than in occidentalis; leaves broader, thicker and darker green.

40. **E. obcordata, Turc.** Leaves thick, broad, blunt, shining; umbels solitary; stalk very broadly compressed, bent downwards, stalk

lets none; lid cylindric-conical, narrower than the tube of the calyx; stamens straight in bud; fruit truncate-ovate, very angular, border compressed, valves slightly exserted.

41. **E. erythronema, Turc.** Leaves narrow, equally green; oil-dots pellucid; umbels solitary; stalklets much elongated; lid conical, filaments red; fruit topshaped, border depressed, valves slightly exserted.

42. **E. cosmophylla, F. M.** Dwarf; leaves thick, equally dull-green; umbels solitary; stalk very short, stalklets almost none; lid semi-globular, short-pointed; fruits semiovate, border depressed, valves exserted.

43. **E. globulus, Lab.** Leaves thick, elongated, equally green; flowers mostly solitary, stalks and stalklets almost none; lid double, the inner crownshaped; fruit large, hemispheric, warty-rough, angular, border broad, depressed, valves exserted, convergent.

44. **E. pachyphylla, F. M.** Dwarf; leaves very thick, broadish, acute, equally green; umbels solitary; stalk and stalklets very short or none; lid semiovate-pyramidal, pointed; filaments yellow; fruit topshaped-hemispheric below, very angular, border broad, ascending, valves slightly exserted; fertile seeds membranously margined.

45. **E. pyriformis, Turc.** Dwarf; leaves thick, equally green; umbels solitary; flowers very large, calyces wrinkled, lid hemispheric, pointed; filaments red or yellow; fruit very large, topshaped-hemispheric, angular, border very broad, ascending, valve slightly exserted; fertile seeds membraneously margined.

46. **E. resinifera, Sm.** Leaves much paler beneath; veins very spreading; umbels solitary; stalk compressed; lid conical, acute; fruit semiovate, border depressed, narrow, valves exserted, pointed.

47. **E. Stuartiana, F. M.** Leaves scattered, stalked, equally dark-green, shining; umbels solitary, few-flowered, stalklets almost none; lid nearly hemispheric; fruits small, semiovate-topshaped, border narrow, rather convex, valves very small, exserted.

48. **E. viminalis, Hook.** Leaves scattered, stalked, falcate-lanceolar, equally green; umbels solitary, mostly three-flowered; stalklets almost none or very short; lid semiovate, mostly short-pointed; fruit semiovate, border somewhat convex, valves exserted.

49. **E. rostrata, Schl.** Leaves scattered, stalked, falcate-lanceolar-equally green; umbels solitary, with several flowers; stalks rather elongated, stalklets conspicuous; lid from an hemispheric base sharp-pointed; fruit below semiglobular, border convex, valves exserted.

50. **E. teritcornis, Sm.** Leaves scattered, stalked, falcate-lanceolar, equally green; umbels solitary, with several flowers; stalks rather elongated, stalklets conspicuous; lid mostly elongate-conical; outer stamens straight in bud; fruits below semiglobular, border convex, valves exserted.

50½. E. mortoniana. Leaves long-stalked, scattered, lanceolar or sickle-shaped, long and rather broad; equally dull green; stalk compressed; about length of calyx tube; stalklet distinct; calyx-tube rough, often slightly ridged, topshaped or truncate-ovate; border of tube has appearance of a pot of some thick fluid boiling over: lid hemispheric-acuminate, the point or beak of the lid is thick and long; buds flattened and angular; valves exserted, generally four or rarely three; bark sheds in long strips. General appearance suggests Eucalyptus globulus; anthers oblong, opening by parallel slits, dorsal gland prominent, style spotted somewhat dilated toward top, stigma not dilated.

51. E. vernicosa, Hook. Dwarf; leaves often very small, mostly ovate, equally dark-green, very shining; flowers 1 to 3; stalks and stalklets very short; lid shining, short-pointed; fruits semiovate, border depressed, valves exserted.

52. E. rudis, End. Leaves thin, falcate-lanceolar, equally dull-green; oil-dots pellucid; umbels solitary; stalklets short; lid broad-conical, transverse edge of the calyx prominent in bud; fruits semiglobular topshaped, border rather convex, valves exserted.

53. E. cornuta, Lab. Leaves equally green; umbels solitary; stalklets almost none, lid very long, unwards cylindrical; filaments yellow, long, straight in bud; fruit bellshaped-semiovate, border depressed, valves very long, awlshaped, coherent.

54. E. Lehmanni, Preiss. Leaves from ovate to oblong or almost lanceolate, obtuse, very thick, the veins very oblique and rather distant; flowers several, often 20 or more together in dense heads upon thick recurved pecuncles 1 to 3 inches long, and sometimes much flattened, the receptacle forming a globose of ½ inch or more in diameter, in which the calyx tubes are more or less immersed; fruits half immersed in the receptacle; the exserted valves connivent into a cone.

55. E. megacarpa, L. M. Leaves equally green; umbels solitary; stalks broadly compressed, stalklets none; lid semiglobular, short pointed; fruit large, almost hemispheric, warty-rough, angular, border broad, depressed, valves exserted, blunt, convergent.

56. E. alpina, Lind. Leaves very thick, broad, blunt, equally green, shining; umbels solitary or flowers single; stalks and stalklets none; lid crownshaped, anthers cordate; fruit hemispheric, border depressed, valves exserted.

57. E. macrocarpa, Hook. Dwarf; leaves opposite, sessile, ovate-cordate, equally whitish-grey; flowers solitary, very large; stalk and stalklets almost none; lid semiovate-conical; filiments red; fruit very large, topshaped-hemispheric; border broad, convex; valves exserted; fertile seeds membranously margined.

58. E. saligna, Sm. Leaves much paler beneath; veins feathery-spreading; umbels solitary; stalk compressed, stalklets very short; lid

hemispheric, short-pointed; fruit semiovate, border depressed, very narrow, valves small, exserted.

59 **E. gomphocephala, D. C.** Leaves thick, shining, slightly paler beneath; umbels solitary; stalk broadly compressed, stalklets none; lid broader than the tube of the calyx, almost hemispheric; fruit large, topshaped, border broad, convex, valves exserted, convergent.

The characters of unusual forms of any species are not covered by this synopsis.

RENANTHEREAE.

Descriptions from Bentham not classified by me:

6. **E. coccifera,** *Hook. f. in Hook. Lond. Journ.* vi. 477, *and Fl. Tasm.* i. 133. *t.* 25. A small tree generally very glaucous. Leaves lanceolate, acuminate or obtuse, mostly 2 to 3 in. long, thick and shining, the veins oblique, not numerous nor very conspicuous. Peduncles axillary or lateral, short, thick and much flattened upwards, each with 3 to 6 flowers, sessile or nearly so. Calyx-tube narrow-turbinate, tapering at the base, prominently angled, fully 3 lines long and not above 2 diameter. Operculum exceedingly short, broad, flat or depressed and rugose. Stamens about 3 lines long, inflected in the bud; anthers reniform with diverging or divaricate cells, confluent at the apex. Ovary short, flat-topped. Fruit obovoidtruncate, scarcely contracted at the orifice and often losing the angles of the calyx, 4 to 5 or even 6 lines diameter, the rim flat and rather broad, the capsule scarcely depressed, with short valves.—Bot. Mag. t. 4637; *E. daphnoides*, Miq. in Ned. Kruidk. Arch. iv. 133.

Tasmania. Summits of the mountains at an elevation of 3000 to 4000 ft., *J. D. Hooker.*

Var, *parviflora.* Flowers much smaller, the peduncles exceedingly short.—Mount Fatigue, *Gunn.*

The species has much the aspect of some thick-leaved forms of *E. amygdalina*, but is readily known by the depressed operculum and longer calyx.

8. **E. dives,** *Schau. in Walp. Rep.* ii. 926. A small tree of 12 ft. Leaves sessile, opposite, cordate or ovate, acute or acuminate, rather large, on one branch the upper ones tending to become alternate and oblique. Peduncles mostly on the stem below the leaves, bearing each a dense umbel of 8 to 12 or even more flowers. Buds clavate. Calyx-tube short and broad, about 2 lines diameter, tapering into a rather thick pedicel longer than the calyx. Operculum short obtuse and hemispherical. Anther-cells divergent and confluent at the apex. Fruit unknown.

N. S. Wales. Forest land north of Bathurst, *A. Cunningham.* Probably an opposite-leaved state of some species very nearly allied to or even identical with *E. obliqua*, of which it has the flowers. I have, however, seen no specimen of the true *E. obliqua* from so far north.

9. **E. obtusiflora,** *DC. Prod.* iii. 220, *and Mem. Myrt. t.* 10. Leaves mostly straight, oblong elliptical or almost lanceolate, acuminate, often all under 3 in. long, but in some luxuriant specimens more falcate, acuminate and attaining 5 in., very thick and rigid, the veins oblique and parallel, but not close, the intramarginal one at a distance from the edge. Peduncles lateral or axillary, somewhat compressed, rigid, with an umbel of 4 to 8 rather large flowers. Buds clavate. Pedicels much thickened upwards. Calyx-tube short and broad, fully three lines diameter. Operculum broadly hemispherical, obtuse or umbonate, thick, shorter than the calyx-tube. Stamens 2 to 3 lines long, all perfect; anthers reniform, with divergent cells usually confluent at the apex. Fruit very hard and woody, ovoid-truncate, above ½ in. long, the orifice scarcely contracted, the rim rather broad and concave, the capsule depressed.—*E. rigida*, Sieb. Pl. Exs.

N. S. Wales. Port Jackson, *Sieber*, *n.* 473; *F. Mueller;* Bargo Brush, *Backhouse.*—Allied to *E. obliqua*, but with much more rigid straighter leaves, the flowers larger, and the fruit much larger and differently shaped. I have not seen De Candolle's specimens, and his figure represents parallel celled anthers, but that is probably the fault of the artist. In other respects it agrees well with our plant.

STRONGYLANTHEREAE.

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24. **E. oligantha,** *Schau. in Walp. Rep.* ii. 926. Leaves all petiolate but very broad, orbicular or ovate, obtuse or shortly acuminate, 3 to 4 in. long, rigidly coriaceous with prominent diverging veins, parallel but rather distant. Umbels 3 to 6-flowered, collected in a short terminal panicle. Peduncles terete. Calyx-tube campanulate, about three lines long and as much in diameter, tapering into a short pedicel. Operculum rather thick, conical, shorter than the calyx. Stamens 2 to 3 lines long, all perfect, inflected in the bud; anthers very small and globular, with distinct parallel cells opening in circular pores or very short slits. Fruit unknown.

N. Australia. Copeland Island, N. coast, *A. Cunningham.* Until the fruit is known, the precise affinities of this species cannot be determined. It is very unlike any other one I have seen.

36. **E. albens,** *Miq. in Ned. Kruidk. Arch.* iv. 138. A tree, attaining 60 to 80 ft., with a dull green persistent bark (*F. Mueller*), separating

in smooth laminæ or strips (C. Stuart), the foliage usually very glaucous or almost mealy-white. Leaves usually large, broad, ovate-lanceolate or lanceolate, often 6 in. long or more, rigid, with oblique veins, the intramarginal one at a distance from the edge. Peduncles lateral, rigid, scarcely flattened, sometimes ¾ in. long, but often much shorter, bearing 4 to 8 rather large flowers. Buds long and acuminate, apparently sessile, but really tapering into short thick angular pedicels. Calyx-tube 3 to 4 lines long and scarcely 2 lines diameter, 2-angled or nearly terete. Operculum conical, acuminate, as long as or rather shorter than the calyx-tube. Stamens 3 to 4 lines long, all perfect, inflected; anthers very small and globular, with distinct parallel cells, opening at length to the base or nearly so. Ovary short, slightly conical in the centre. Fruit obovoid-oblong, truncate, nearly ½ in. long, the rim narrow, the capsule deeply sunk.

N. S. Wales. Macquarrie river, *A. Cunningham;* New England, "White Gum," *C. Stuart;* between Alford's and the Range, "Box," *Leichhardt.*

Victoria. Poor plains, between Ten-mile Creek and Broken River, "White Box," *F. Mueller.*

A very distinct species with something of the habit of the *Robustæ*, but with the anthers of the *Micranthera*. F. Mueller refers it to *E. pallens*, DC., which I have not seen. De Candolle's character agrees rather better with *E. dealbata* than with *E. albens*, but the short hemispherical operculum he describes occurs in neither.

37. **E. Bowmani,** *F. Muell. Herb.* Stature and bark unknown. Leaves ovate-lanceolate or broadly lanceolate, mostly 4 to 6 in. long, straight or falcate, obtuse or acuminate, rigid, with oblique veins, the marginal one at a distance from the edge, like those of *E. albens*, but not glaucous. Peduncles axillary or lateral, more or less flattened, bearing 4 to 8 rather large flowers. Buds obtuse, tapering into a short very thick pedicel or nearly sessile. Calyx-tube obovoid or turbinate, thick, about 2 lines long and as much diameter. Operculum thick, obtuse, longer than the calyx-tube. Stamens 3 to 4 lines long, the filaments slender, inflected in the bud, but not showing the acute angle of *E. corynocalyx;* anthers very small and globular, but with distinct parallel cells, opening longitudinally. Ovary conical in the centre. Fruit unknown.

Queensland, *Bowman.* I have some hesitation in describing the species without having seen the fruit, but it appears quite distinct from any other one known to me. It seems to be allied to *E. albens* and *E. corynocalyx*, but differs from both in the shape of the flowers.

Specimens of two other trees or shrubs, in F. Mueller's collection, are probably closely allied to, if not varieties of the same; one from the head of the Gwydir, *Leichhardt*, in bud only, is glaucous like *E. albens*, and has the calyx-tube shorter and the operculum longer than in *E. Bowmani*, which it agrees with in other respects. The other from Mount

Elliot, *Fitzalan*, in flower, only differs from *E. Bowmani* in the upper umbels almost paniculate, in the more distinct pedicels and in the operculum rather shorter and broader.

44. **E. brachypoda,** *Turcz. in Bull. Mosc.* 1849, ii. 21. A tall shrub, or small or moderate sized tree, the bark varying from smooth and whitish to dark and rugged, persistent or shed in large patches (*Oldfield*) dark and rough on the trunk, smooth whitish and deciduous on the branches (*F. Mueller*). Leaves from ovate obtuse and under 2 in. to long-lanceolate obtuse acute or acuminate and attaining 6 to 8 in., more or less pale or glaucous, with numerous very fine parallel almost transverse veins, scarcely conspicuous when the leaf is thick, the marginal one near or close to the edge. Peduncles short terete or nearly so, each with about 3 to 6 or sometimes more small flowers; umbels usually 3 or 4 together in short panicles either terminal or in the upper axils, or rarely the lower ones solitary and axillary. Calyx short, broad and open, 1 to 1¼ lines diameter. Operculum conical or obtuse, not longer than the calyx-tube. Stamens 1 to 2 lines long, inflected in the bud; anthers very small, globular, with distinct parallel cells. Ovary convex in the centre. Fruit almost hemispherical, rarely 2 lines diameter, the orifice open or almost dilated, the rim narrow, the capsule slightly sunk, but very convex in the centre, the valves protruding when open.—*E. brevifolia*, F. Muell. in Journ. Linn. Soc. iii. 84; *E. microtheca*, F. Muell. in Journ. Linn. Soc. iii. 87.

N. Australia. N. W. coast, *A. Cunningham;* table land of the upper Victoria river, "Box-tree," also in the scrub between Flinders and Albert rivers, Gulf of Carpentaria, *F. Mueller*. Macdonnell Ranges, *M'Douall Stuart's Expedition*.

N. S. Wales. Between the Darling river and Barrier Range, *Victorian Expedition*.

S. Australia. Cooper's Creek, *Howitt's Expedition*.

W. Australia, *Drummond*, *4th Coll. n.* 73. Wet places near the Murchison river, among flooded gums, called "Colaille," *Oldfield*, who remarks on the variability of the bark, but there appears to be some confusion in his notes.

With the habit and inflorescence of *E. crebra*, this species differs from all others of the group in the very open fruit with exserted valves.

45. **E. brachyandra,** *F. Muell. in Journ. Linn. Soc.* iii. 97. A tall shrub or small tree. Leaves ovate or oblong, on long petioles, very obtuse, 2 to 4 in. long, thick with numerous parallel very diverging veins, fine but not very close. Flowers not seen. Umbels several together in a short panicle. Calyx after flowering very small, ovoid-globose, with a few very short stamens with minute globose anthers remaining about the orifice. Fruit urceolate-globose, scarcely more than 1 line long, the rim thin, the capsule sunk.

N. Australia. Rocky declivities of the Upper Victoria river, *F. Mueller*. The specimens preserved are very fragmentary.

100. **E. concolor,** *Schau. in Pl. Preiss.* i. 129. A tree of 30 to 40 ft., with a smooth bark (*Oldfield*), a small tree of 8 to 12 ft. (*Preiss*), with much of the aspect of *E. decipiens*, but larger and more rigid in all its parts. Leaves ovate-lanceolate to lanceolate-acuminate, often 4 to 5 in. long, thick and rigid, the fine diverging veins numerous and parallel but scarcely conspicuous, the intramarginal one nearer the edge than in *E. decipiens*. Peduncles short, axillary, broad and flat but thick, each with a head of 6 to 12 or more sessile flowers. Calyx-tube turbinate, thick and often angled, but otherwise smooth, about 3 lines long. Operculum conical or acuminate, rather longer than the calyx-tube. Stamens inflected; anthers globular, small, but not so small as in *E. decipiens*, with distinct parallel cells. Ovary conical or convex in the centre. Fruit globose-truncate, about 4 lines diameter, contracted at the orifice, the rim broad, flat or slightly convex, the capsule sunk, but the points of the valves usually protruding.

W. Australia. Doubtful-Island Bay and shady ravines, Point Irwin, *Oldfield;* near Freemantle, *Preiss*, *n.* 225; also *Drummond*, *4th Coll. n.* 77.

101. **E. goniantha,** *Turcz. in Bull. Mosc.* 1847, i. 163. Leaves ovate-lanceolate or lanceolate-acuminate, mostly falcate, rarely under 3 in. and sometimes above 4 in. long, thick and rigid, the very fine rather oblique veins numerous and parallel but scarcely conspicuous, the intramarginal one close to or very near the edge. Peduncles axillary or lateral, short, rather thick and flattened, mostly recurved, each with 4 to 8 flowers on short thick angular pedicels. Calyx-tube very broadly turbinate, thick and very prominently ribbed, 3 to 4 lines diameter. Operculum strongly ribbed, nearly hemispherical at the base, with a thick obtuse beak as long as or rather longer than the calyx-tube. Stamens 4 to 5 lines long, inflected in the bud; anthers small, ovate, with parallel distinct cells. Fruit depressed-globular or subglobular, truncate, hard, more or less ribbed, or sometimes almost smooth, 4 to 5 lines diameter, somewhat contracted at the orifice, the rim rather broad and nearly flat, the capsule somewhat sunk, but the valves occasionally protruding.

W. Australia. King George's Sound or to the eastward, *Collie; Baxter; Drummond, 3rd Coll. n.* 71; Franklin river, *Maxwell* (in fruit only with rather broad leaves).

104. **E. decurva,** *F. Muell. Fragm.* iii. 130. A large shrub of 10 to 12 ft., or a small tree of 10 to 30 ft., with a smooth bark (*Oldfield, Maxwell*). Leaves lanceolate, usually narrow, rarely ovate-lanceolate, acuminate, rarely exceeding 4 in. and often under 3 in. long, thick or rather thin, the veins diverging, but not close and scarcely visible, the intramarginal one more or less distant from the edge. Peduncles axillary

or lateral, terete, or somewhat flattened, each bearing an umbel of 3 to 7 flowers usually recurved and on rather long pedicels, but sometimes erect. Calyx-tube ovoid or almost cylindrical, 2 to 2½ lines long and nearly 2 lines diameter, abruptly contracted or obtuse at the base, not ribbed. Operculum hemispherical and broad at the base, with a central beak sometimes very short, sometimes above 2 lines long. Stamens about 3 lines long, the filaments slender and acutely inflected as in *E. uncinata* and *E. corynocalyx;* anthers very small, globular, with distinct parallel cells. Ovary short, convex or conical in the centre. Fruit ovoid, contracted at the orifice, 3 to 4 lines long and rather less in diameter, the rim narrow, the capsule deeply sunk.

W. Australia. Low flats and rich soil to the east of Kojonerup from the Stirling Range to East Mount Barren, *Maxwell*, also *Drummond, 5th Coll. n.* 186, all with narrow not very thick leaves; from Kalgan river and King George's Sound to the eastward, *Harvey*, *Oldfield*, *Maxwell*, with broader and thicker leaves; Vasse river, *Gilbert*, *n.* 266, with thick but narrow leaves.

A specimen in fruit only from Murchison river, *Oldfield*, looks like the same species. The *E. doratoxylon*, which in many respects resembles this species, differs in the leaves mostly opposite as well as in the stamens. The *E. decurva* itself is very closely allied to *E. oleosa*, but the shape of the calyx and fruit and the arrangement of the stamens are somewhat different.

ORTHANTHEREAE.

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33. **E. micranthera,** *F. Muell. Herb.* A shrub, of 6 to 10 ft., with a smooth bark (*Maxwell*). Leaves oblong-lanceolate, acuminate or almost obtuse, 2 to nearly 4 in. long, very thick and smooth so as wholly to conceal the veins. Peduncles very short, often flattened, with 3 to 6 flowers like those of *E. uncinata* or *E. oleosa*, but larger. Calyx-tube turbinate, 2 to nearly 3 lines long, tapering into a very short thick pedicel or almost sessile. Operculum very obtuse and shorter than the calyx-tube. Stamens inflected, sometimes almost as acutely so as in *E. corynocalyx* and *E. uncinata*, but the filaments not so fine and the anthers very minute, with parallel contiguous cells. Ovary flat-topped. Fruit globose-truncate, 4 to 5 lines diameter, somewhat contracted at the orifice, the rim broad, flat or slightly concave, the capsule very slightly sunk.

W. Australia. Sandy hummocks, from Israelite Bay to Eyre's Relief, *Maxwell.*

Possibly a form of *E. uncinata*, but both the operculum and the stamens appear different.

54. **E. conoidea,** *Benth.* Leaves narrow-oblong or lanceolate, mostly obtuse and under 3 in. long, thick and shining, the very oblique veins scarcely conspicuous, the intramarginal one at a distance from the edge. Peduncles axillary or lateral, usually recurved, terete or slightly angular, each with 3 to 5 rather large pedicellate flowers. Calyx-tube obconical, more or less distinctly ribbed, 3 lines long or rather more, tapering into the pedicel. Operculum broad and conical, smooth or ribbed, not thick, nearly twice as long as the calyx-tube. Stamens nearly ½ in. long, inflected in the bud, raised by the thick disk ½ to 1 line above the border of the calyx; anthers oblong, with parallel distinct cells. Fruit turbinate-truncate, 4 to 6 lines long and as much in diameter on the top, the rim raised above the calyx-border, broad and flat or concave, the capsule level with it or more or less depressed, the short broad valves often protruding when open.

W. Australia, *Drummond, 5th Coll. n.* 37.

Var. *marginata.* Border of the calyx expanded into a prominent horizontal or reflexed ring.—*Drummond, 3rd Coll. n. 56.*

65. **E. grossa,** *F. Muell. Herb.* A stunted shrub (*Maxwell*). Leaves from ovate and obtuse to lanceolate and acute, very thick and shining, under 3 in. long, the veins oblique, rarely conspicuous, the intramarginal one at a distance from the edge. Peduncles axillary or lateral, often recurved, thick and much flattened, with usually 3 large sessile flowers. Calyx-tube turbinate, prominently ribbed, 4 to 5 lines long. Operculum oblong, very obtuse, thin and smooth, as long as or rather shorter, perhaps sometimes longer than the calyx-tube. Stamens about ½ in. long, inflected in the bud; anthers ovate-oblong, with parallel distinct cells. Ovary short, convex in the centre. Fruit not seen.

W. Australia. Phillips river and its tributaries, *Maxwell.* I feel uncertain as to the affinities of this species, the smooth cylindrical obtuse operculum is like that of some of the *Cornutæ*, but the stamens are much inflected in the bud, and the flowers are otherwise quite those of the larger forms of *E. incrassata.*

71. **E. annulata,** *Benth.* A tall shrub with a smooth bark (*Maxwell*). Leaves narrow-lanceolate, acuminate, mostly under 4 in. long, thick and smooth with oblique veins usually very indistinct, the intramarginal one near the edge. Peduncles axillary or lateral, short, thick, flat, and almost as broad as long, each with about 6 to 12 sessile flowers. Calyx-tube turbinate-campanulate, about 3 lines diameter. Operculum 6 to 8 lines long, usually incurved and very obtuse or almost clavate at the end. Stamens straight as in *E. cornuta*, but apparently of a yellowish-white colour as in *E. macrandra*, the margin of the disk that bears them forming a raised inflexed ring about ¾ line broad; anthers oblong with parallel cells. Ovary conical at the top, tapering into the style. Fruit depressed-globose, 4 to 5 lines diameter, the convex rim protruding into

a thick ring, quite distinct from the valves, which project much, tapering into long erect or connivent points formed by the persistent base of the style.

W. Australia. Salt River, *Maxwell.*

73. **E. macrandra,** *F. Muell. Herb.* A shrub or small tree with a smooth bark (*Maxwell*). Leaves from ovate-lanceolate to narrow-lanceolate, rarely exceeding 4 in., very thick and smooth, the veins more numerous and more diverging than in *E. cornuta*, and the intramarginal one usually nearer the edge, but generally scarcely visible. Peduncles rigid and flattened, mostly ½ to 1 in. long, with 8 to 16 or even more flowers, sessile or on very short pedicels. Calyx-tube obovoid-campanulate, usually 2½ to 3 lines long and rather less in diameter, but in some specimens smaller. Operculum usually above 1 in. long. Stamens when dry yellowish, erect in the bud as in *E. cornuta*, the edge of the disk inflected; anthers oblong, with parallel cells. Ovary flat-topped, the style not thickened at the base. Fruit semiovoid, truncate. 3 to 4 lines diameter, or in some specimens rather smaller, the rim narrow, on a level with the calyx as well as the flat-topped capsule, the small valves not protruding.

W. Australia. From the valleys S. of Stirling range to Salt River and Phillips range, *Maxwell.*

75. **E. spathulata,** *Hook. Ic. Pl. t. 611.* A shrub of 6 to 8 ft. or rather more. Leaves linear, linear-lanceolate or rarely oblong-lanceolate, straight or slightly falcate, under 3 in. long, thick and rigid so as wholly to conceal the veins. Peduncles short, axillary or lateral, flattened but usually not very broad, each with about 4 to 6 flowers. Calyx-tube obovoid, thick, about 2 lines long, tapering into a short thick pedicel. Operculum cylindrical, obtuse, often narrower than the calyx and about twice as long. Stamens erect, slightly flexuose, about 4 lines long, the border of the staminal disk inflected over the sunk ovary; anthers oblong, parallel-celled. Style slightly thickened at the base. Fruit obovoid, 3 lines or rather more in length and nearly as much in diameter, contracted at the orifice, which is further closed by the rather broad flat rim; capsule sunk, but the points of the valves sometimes slightly protruding.

W. Australia. Between Perth and King George's Sound, *Harvey; Drummond, 3rd Coll. n. 68.*

Var. *grandiflora.* Leaves rather broader. Flowers and fruits larger. —Phillips range, *Maxwell.*

The species has much of the aspect of the narrow-leaved forms of *E. redunca*, but in that the operculum is acuminate, and the stamens more or less inflected in the bud.

76. **E. pallidifolia,** *F. Muell. Fragm.* iii. 131. A small tree with an ash-coloured smooth bark (*F. Mueller*). Leaves ovate-oblong or lan-

ceolate, very obtuse and rarely 3 in. long, thick and smooth, the fine parallel very diverging veins scarcely visible, the intramarginal one close to the edge. Peduncles axillary or lateral, short, nearly terete, with 4 to 6 nearly sessile or shortly pedicellate flowers. Calyx-tube short, about 2 lines diameter. Operculum hemispherical or obtusely conical, shorter than the calyx-tube. Stamens about 2 lines long, inflected in the bud; anthers ovate with parallel distinct cells. Ovary flat-topped. Fruit obovoid-globose, 3 to 4 lines diameter, slightly contracted at the orifice, the rim broad, convex, and prominent, the capsule not sunk, the valves protruding and sometimes acuminate by the persistent split base of the style.

N. Australia. Sandstone table-land on the Upper Victoria river and Sturt's Creek, *F. Mueller*.—As observed by F. Mueller, this resembles in some respects *E. oleosa*, but the venation of the leaves and the fruit are different.

79. **E. pachyloma,** *Benth.* A shrub of 5 ft. (*Maxwell*). Leaves mostly lanceolate or linear-lanceolate, acuminate, under 3 in. long, thick and rigid, the very oblique veins scarcely conspicuous, the intramarginal one at a distance from the edge. Peduncles axillary or lateral, short and thick, terete or slightly angular, each with 2 to 4 rather large flowers. Calyx-tube broadly turbinate or almost hemispherical, about 4 lines diameter, smooth and tapering into the very short thick pedicel. Stamens pale-coloured, ½ in. long or more, slender and inflected in the bud; anthers ovate with distinct parallel cells. Disk concave. Fruit sessile, depressed-globose, 7 to 8 lines diameter, with the very thick broad convex and raised rim of *E. Oldfieldii*, but without any depressed centre, the capsule not sunk, and the small valves protruding as in *E. rostrata*.

W. Australia. *Drummond, 4th Coll. n. 64;* sand plains, Kalgan river, *Oldfield;* valleys of the Stirling range, *Maxwell.*

80. **E. Drummondii,** *Benth.* Leaves from ovate-oblong to lanceolate, obtuse or acuminate, under 3 in. long, very thick, with very fine close parallel veins, very diverging or almost tranverse, but scarcely conspicuous, the intramarginal one close to the edge. Peduncles axillary or lateral ½ to 1½ in. long, terete or nearly so, each bearing an umble of 3 to 6 rather large flowers on terete pedicels often ½ in. long. Calyx-tube broadly hemispherical, hard and smooth, 4 to 5 lines diameter. Operculum conical, rather broader and considerably longer than the calyx-tube. Stamens about ½ in. long, inflected in the bud; anthers rather small, ovate, with distinct parallel cells. Disk very broad, nearly flat, forming a prominent ring round the ovary, of which the obtusely conical centre protrudes about 1 or 1½ lines above the disk at the time of flowering. Fruit unknown.

W. Australia. Between Swan River and King George's Sound, *Drummond, 2nd Coll. n. 86; also 5th Coll.*

81. **E. orbifolia,** *F. Muell. Fragm.* v. 50. A shrub of 5 ft. (*C.*

Harper), the foliage nearly white or yellowish in the single small specimen seen. Leaves nearly orbicular, very obtuse, under 2 in. diameter, very thick and smooth, the veins irregular and distant but scarcely conspicuous. Peduncle axillary, terete, not ½ in. long, with the scars of 5 flowers. Pedicels short and terete. Calyx-tube broadly hemispherical, smooth, about ½ in. diameter. Operculum thick, conical, nearly twice as long as the calyx-tube. Stamens very numerous, inflected in the bud; anthers ovate, with distinct parallel cells. Disk narrow round the conical summit of the ovary, which protrudes 3 or 4 lines above the border of the calyx, tapering into the short thick style. Fruit unknown.

W. Australia. Granite hills in the interior to the north of Swan river, *C. Harper.* Although evidently allied to *E. Drummondi*, this appears to be specifically distinct both in the leaves and the parts of the flowers.

83. **E. leptopoda,** *Benth.* Branchlets slender. Leaves linear-lanceolate, acuminate, often above 4 in. long, not very thick but the veins inconspicuous. Peduncles axillary or lateral, slender, terete or slightly flattened, bearing each a loose umbel of 10 to 15 small flowers on slender pedicels much longer than the buds. Calyx-tube broadly turbinate or almost hemispherical, about 1½ lines diameter. Operculum conical, from a little shorter to a litttle longer than the calyx-tube and not so broad. Stamens inflected in the bud, flexuose, not 2 lines long; anthers ovate or almost globose, with parallel distinct cells. Fruit depressed-globular, nearly 3 lines diameter, the rim broad, flat or slightly convex, the capsule not sunk, the valves protruding when open.

W. Australia, *Drummond, 5th Coll. Suppl. n. 33 and 36, also n. 151 and 188 of other sets.*

In the specimens n. 188 the buds are rather larger than in the others, the peduncles and pedicels shorter and the fruits smaller, scarcely 2 lines diameter, with long prominent points to the valves.

84. **E. cinerea,** *F. Muell. Herb.* A moderate-sized tree, with a whitish-brown persistent bark. somewhat fibrous, the foliage more or less glaucous or mealy white. Leaves opposite, sessile, cordate, ovate or ovate-lanceolate, obtuse or acute, mostly 2 to 4 in. long. Peduncles axillary or in short terminal corymbs, terete or nearly so, each with 3 to 7 pedicellate flowers. Calyx broadly turbinate, about 2 lines diameter, or rather more. Operculum conical, shorter than the calyx-tube. Stamens 2 to 3 lines long, inflected in the bud; anthers small but ovate, with distinct parallel cells. Ovary convex in the centre. Fruit semiglobose or subglobose-truncate, about 3 lines diameter, often slightly contracted at the orifice, the rim thin, the capsule very slightly sunk but the valves protruding.

N. S. Wales. Lachlan river, near Bathurst, *A. Cunningham;* also Lake George, *Herb. F. Mueller.*

F. Mueller (Fragm. ii. 70) unites with this *E. pulverulenta*, of which it may be a variety, but, as far as the specimens go, the differences in the leaf, in the size of the flower, and in the shape of the fruit appear to be constant. It may, however, be an opposite-leaved state of *E. dealbata*, and possibly, as well as that species, a form of *E. viminalis*.

85. **E. dealbata,** *A. Cunn.; Schau. in Walp. Rep.* ii. 924. A small stunted tree, the foliage often glaucous-white, the bark rugose or separating in scales, leaving the inner bark white and smooth (*C. Stuart*). Leaves from ovate to ovate-lanceolate and under 4 in. long or sometimes lanceolate and longer, obtuse or acute, the veins oblique and irregular, the intramarginal one at a distance from the edge, all usually conspicuous. Peduncles axillary or lateral, very short and scarcely flattened, bearing each 3 to 6 flowers on short pedicels. Calyx-tube very open, about 2 lines diameter and not so long. Operculum broad, rather thin, hemispherical or conical, longer than the calyx-tube. Stamens about 3 lines long, inflected in the bud; anthers ovate, with parallel distinct cells. Ovary more or less conical in the centre, tapering into the style. Fruit almost hemispherical, about 3 lines diameter, the rim flat, the valves protruding even before they open.

Queensland. In the interior, *Mitchell.*

N. S. Wales. Rocky situations in the interior, *A. Cunningham;* New England, *C. Stuart*, also probably a specimen in young bud of a "Box," *Leichhardt;* Mudgee, "River Gum," *C. Moore.* It is possible that this may prove to be the true *E. pallens*, DC. F. Mueller thinks it may be reducible to a variety of *E. viminalis*.

88. ? **E. exserta,** *F. Muell. in Journ. Linn. Soc.* iii. 85. A moderate-sized or small tree, the bark ash-brown, rough and fissured outside and falling in fragments, somewhat fibrous inside (*F. Mueller*), dark iron-grey and roughish (*Oldfield*). Leaves lanceolate, mostly falcate and acuminate, 3 to 6 in. long or sometimes much more, the lower ones often ovate, rather thick, the veins rather regular, numerous and oblique, the intramarginal one not close to the edge. Peduncles axillary or lateral, terete or scarcely compressed, bearing each 3 to 8 flowers on distinct often rather long pedicels. Calyx-tube hemispherical, about 2 lines diameter (or sometimes nearly 3 ?). Operculum hemispherical or broadly conical, more or less beaked, acuminate and rather longer than the calyx-tube. Stamens about 2 lines long or rather more, inflected in the bud; anthers ovate with parallel distinct cells. Fruit nearly globular, 3 to 4 lines diameter, the rim broad and very prominent, almost conical, the capsule not sunk, and the valves entirely protruding even before they open.

Queensland. Burnett river, *F. Mueller*:

W. Australia. Murchison river, *Oldfield.*

This is probaly the same as *E. rostrata*, notwithstanding the differences described in the bark. There may be also some confusion in Old-

field's specimens, the larger-flowered ones may belong to *E. rudis*, which differs in its large flowers, shorter pedicels, and in the much larger fruit with a flat rim.

97. **E. pellita,** *F. Muell. Fragm.* iv. 159. A tree of 40 to 50 ft., with a rough dark grey bark (*Dallachy*). Leaves ovate lanceolate or almost ovate, acuminate, nearly straight, 5 to 6 in. long or more, rigid, with numerous parallel almost transverse veins, the intramarginal one near the edge. Peduncles axillary or lateral, stout and much flattened, often 1 in. long, each with about 4 to 8 rather large flowers on thick angular pedicels often as long as the calyx-tube. Calyx-tube much broader and shorter than in *E. botryoides*, 5 to nearly 6 lines diameter and more or less angular. Operculum thick, hemispherical, broader than the calyx-tube, with a short obtuse beak. Stamens about ½ in. long, somewhat raised above the calyx-border by the disk, inflected in the bud; anthers ovate-oblong, with parallel distinct cells. Ovary very conical in the centre. Fruit subglobose-truncate or nearly hemispherical, 6 to 8 lines diameter, not contracted at the orifice, the rim raised above the calyx-border, slightly convex and rather broad, the capsule scarcely sunk, the valves much projecting.—*E. spectabilis*, F. Muell. Fragm. v. 45.

Queensland. Rockhampton, *Dallachy.* The species, as observed by F. Mueller, resembles *E. botryoides*, but differs in the larger especially broader flowers, in the conical ovary, and in the shape of the fruit. It is, however, very closely allied to *E. saligna* and *E. resinifera*, differing chiefly in the size of its leaves, flowers, and fruit, and should perhaps include the var. *grandiflora*, which I have referred to the latter.

102. **E. falcata,** *Turcz. in Bull. Mosc.* 1847, i. 163. A shrub of 10 to 12 ft. (*Maxwell*). Leaves lanceolate, acuminate, often falcate, mostly under 4 in. long, thick and smooth, the very fine oblique veins scarcely visible. Peduncles axillary or lateral, terete or slightly angular, each with about 6 to 12 flowers on slender pedicels of 3 to 4 lines. Calyx-tube short, depressed, about 2 lines diameter, thick, and more or less distinctly furrowed, but not so much so as in *E. goniantha*. Operculum conical, acuminate, fully twice as long as and much narrower than the calyx-tube. Stamens 2 to 3 lines long, or rather more, inflected in the bud; anthers ovate, with parallel distinct cells. Fruit depressed-globular, 3 to 4 lines diameter, much contracted at the orifice, the rim narrow and flat, but the disk within the staminal margin forming a protruding ring over the capsule, which is sunk, but the long points of the valves, formed by the split base of the style, usually protrude.

W. Australia. *Drummond, 3rd Coll- n. 70;* plains to the north and south of Stirling range, *Maxwell.*

107. **E. grandifolia,** *R. Br. Herb.* A small tree, with the outer bark brown and deciduous, the inner whitish and very smooth (*R. Brown*). Leaves opposite or nearly so, petiolate, from ovate to ovate-

lanceolate, 4 to 6 in. long in the specimens, but probably often larger, rigid, with rather fine diverging veins, the intramarginal one remote from the edge. Flowers rather large, on pedicels of ½ to ¾ in., 3 to 10 together, rather clustered than umbellate on a very short lateral peduncle, reduced sometimes to a tubercle (probably the inflorescence consists of several umbels reduced to 1 or 2 flowers each). Calyx-tube very short, broad, and open, 4 to nearly 5 lines diameter. Operculum convex or almost hemispherical, obtuse or umbonate, much shorter than the calyx-tube. Stamens 4 to 5 lines long or rather more, inflected in the bud; anther oblong, with parallel distinct cells. Ovary flat topped. Fruit unknown.

N. Australia. Islands of the Gulf of Carpentaria, *R. Brown* (*Herb. R. Brown*).

112? **E. loxophleba,** *Benth.* A tree from 10 to 30 ft. high, with a rough ash-grey fibrous bark (*Oldfield*), 40 to 45 ft., the bark separable in layers (*Preiss*). Leaves lanceolate, acuminate, narrow and often 4 to 5 in. long or the lower one shorter and broader, all rather rigid with very oblique rather distant and prominent veins, the intramarginal one distant from the edge. Peduncles axillary or lateral, terete or slightly flattened, each with a dense umbel of 6 to 12 flowers. Calyx-tube obconical, 2 to 2½ or rarely nearly 3 lines long, tapering into a short pedicel. Operculum hemispherical or obtusely conical, shorter than the calyx-tube. Stamens scarcely exceeding 2 lines, inflected in the bud, the filaments usually dark-coloured in the dry specimens; anthers small, with parallel distinct cells. Fruit narrow-obovoid, truncate, straight or slightly contracted at the orifice, rarely above 3 lines long and 2 lines diameter, the rim narrow, the capsule deeply sunk.—*E. amygdalina*, Schau. in Pl. Preiss. i. 130 (from the description given), not of Labill.; *E. fruticetorum*, F. Muell. Fragm. ii. 57 (as to the W. Australian specimens).

W. Australia. Swan River and Darling range, *Collie; Drummond, 2nd Coll. n. 82;* York district, *Preiss. n. 246* (and 248?); Murchison river and Champion Bay, "York Gum," *Oldfield.*

The "Yandee," a tree of 40 to 45 ft., with a nearly black persistent furrowed bark consisting of strap-like pieces, from the Murchison river, *Oldfield*, appears to be otherwise precisely the same.

Var. *fruticosa.* A shrub branching from the ground, the leaves rather broader, the flowers rather larger, the peduncles more flattened.—Murchison river, *Oldfield; Salt river, Maxwell.*

115. **E. perfoliata,** *R. Brown, Herb.* A large shrub of 10 ft. or more (*A. Cunningham*). Leaves opposite, connate, 6 to 8 in. long and 3 to 4 in. broad, very obtuse, glaucous with numerous parallel transverse veins. Flowers large, sessile in heads of 4 to 6, on terete peduncles forming a corymbose terminal panicle. Calyx-tube thick, broadly turbinate, smooth or nearly so, 7 to 8 lines long and as much in diameter. Oper-

culum not seen. Stamens above ½ in. long, inflected in the bud; anthers small, ovate-oblong, with parallel distinct cells. Fruit urceolate, 1½ in. long and above 1 in. diameter, smooth, the rim concave, the capsule sunk. Seeds not seen.

127. **E. dichromophloia,** *F. Muell. in Journ. Linn. Soc.* iii. 89. A moderate-sized or large tree, the bark smooth, ash-grey, at length separating from the inner reddish bark (*F. Mueller*). Leaves in the imperfect specimens very long, lanceolate, narrow, thick, with numerous, very fine, close, parallel veins, the intramarginal one scarcely distant from the edge. Umbels several-flowered, forming loose, terminal, corymbose panicles. Young buds obovoid, with a very short obtuse operculum; perfect flowers unknown. Anthers of *E. corymbosa*. Fruit urceolate-globose, with a contracted neck, smooth, attaining sometimes ½ in. diameter, but mostly much smaller; the rim thin, the capsule sunk. Perfect seeds broadly winged on one side.

128. **E. pyrophora,** *Benth.* Nearly allied to the preceding four species, but apparently to be distinguished, unless all be considered as forms of *E. corymbosa*. Leaves long, narrow, and thicker than in any of them. Inflorescence the same. Buds obovoid-pear-shaped, the very obtuse operculum undistinguishable from the calyx-tube till it separates, and then often tearing off irregularly. Flowers larger than in *E. terminalis*, the calyx-tube very broad and open, varying from 4 to 6 lines diameter. Stamens of the allied species. Fruit globose or slightly ovoid, contracted at the orifice, without a distinct neck, the rim thin, the capsule sunk. Seeds apparently winged, but not seen perfect.

UNKNOWN ANTHERS.

93. **E. patellaris,** *F. Muell. in Journ. Linn. Soc.* iii. 84. A tall tree with a rough furrowed persistent dull whitish bark (*F. Mueller*). Leaves lanceolate, falcate, acuminate, about 4 to 6 in. long, the veins rather numerous and regular, oblique, the intramarginal one rather distant from the edge. Perfect flowers unknown. Inflorescence perhaps compound. Calyx-tube (only seen in a diseased persistent bud) hard, hemispherical, about 5 lines diameter, the border prominent. Operculum much depressed, umbonate. Fruit pedicellate, broadly urceolate, about 5 lines diameter, the orifice dilated, the rim broad and flat, the valves protruding.

N. Australia. Dry banks of the Roper river, (*F. Mueller*). Described from specimens far too imperfect to determine the affinities.

116. **E. ferruginea,** *Schau. in Walp. Rep.* ii. 926. A moderate-sized tree, with a rough persistent dark grey bark (*F. Mueller*), the

young branches and often the foliage more or less rusty-pubescent, or the branches bispid with a few stiff hairs or bristles, but sometimes quite glabrous. Leaves large, often 4 to 5 in. diameter, sessile, opposite, cordate orbicular or oblong, mostly obtuse and sometimes undulate. Flowers rather large, the umbels in a dense terminal corymbose panicle, or in one specimen a single umbel axillary. Peduncles and pedicels short, terete. Calyx-tube very broadly campanulate, 6 to 8 lines diameter. Operculum broadly conical, shorter than the calyx-tube. Fruit ovoid, when perfect about 1 in. long and ¾ in. diameter, contracted towards the orifice, the rim narrow, the capsule deeply sunk. Seeds winged.—F. Muell. in Journ. Linn. Soc. iii. 95; *E. confertiflora*, F. Muell. l. c. 96.

N. Australia. Copeland island, N. W. coast, *A. Cunningham;* Victoria river and Arnhem's Land, *F. Mueller.*

GLOSSARY

OR

DICTIONARY OF TERMS USED IN DESCRIBING PLANTS.

A, at the beginning of words of Greek derivation, commonly signifies a negative, or the absence of something ; as *a*petalous, without petals ; *a*phyllous, leafless, etc. If the word begins with a vowel, the prefix is *an ;* as *an*antherous, destitute of anther.

Abnormal : contrary to the usual or the natural structure.

Aboriginal : original in the strictest sense ; same as indigenous.

Abortive : imperfectly formed, or rudimentary.

Abortion : the imperfect formation, or non-formation of some part.

Abrupt : suddenly terminating ;

Abruptly pinnate : pinnate without an odd leaflet at the end.

Acaulescent (*acaulis*) : apparently stemless ; the proper stem bearing the leaves and flowers, being very short or subterranean, as in Bloodroot, and most Violets.

Accessory : something additional ; as *Accessory buds.*

Accrescent : growing larger after flowering, as the calyx of Physalis.

Accumbent : lying against a thing The cotyledons are accumbent when they lie with their edges against the radicle.

Acerose : needle-shaped, as the leaves of Pines.

Acetabuleform : saucer-shaped.

Achenium (plural *achenia*) : a one-seeded, seed-like fruit.

Achlamydeous (flower) : without floral envelopes ; as Lizard's-tail.

Acicular : needle-shaped ; more slender than acerose.

Acinaciform : scymitar-shaped, like some bean-pods.

Acines : the separate grains of a fruit, such as the raspberry.

Acorn : the nut of the Oak.

Acotyledonous : destitute of cotyledons or seed-leaves.

Acrogenous : growing from the apex, as the stems of Ferns and Mosses.

Acrogens, or *Acrogenous Plants :* the higher Cryptogamous plants, such as Ferns, etc.

Aculeate : armed with prickles, i. e. *aculei ;* as the Rose and Brier.

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Aculeolate: armed with small prickles, or slightly prickly.

Acuminate: taper-pointed.

Acute: merely sharp-pointed, or ending in a point less than a right-angle.

Adelphous (stamens): joined in a fraternity (*adelphia*): see *monadelphous* and *diadelphous*.

Adherent: sticking to, or, more commonly, growing fast to another body.

Adnate: growing fast to; it means born adherent. The Anther is adnate when fixed by its whole length to the filament or its prolongation, as in Tulip-tree.

Adpressed, or *appressed:* brought into contract, but not united.

Adscendent, *ascendent*, or *ascending:* rising gradually upwards.

Adsurgent, or *assurgent:* same as ascending.

Adventitous: out of the proper or usual place.

Aventive: applied to foreign plants accidentally or sparingly spontaneous in a country, but hardly to be called naturalized.

Æquilateral: equal sided; opposed to oblique.

Æstivation: the arrangement of parts in a flower-bud.

Air-cells or *Air-passages:* spaces in the tissue of leaves and some stems.

Akenium, or *akene*. See *achenium*.

Ala (plural *alœ*): a wing; the side petals of a papilionaceous corolla.

Alabastrum: a flower-bud.

Alar: situated in the forks of a stem.

Alate: winged, as the seeds of Trumpet-Creeper, the fruit of the Maple, Elm, etc.

Albescent: whitish, or turning white.

Albumen of the seed; nourishing matter stored up with the embryo, but not within it.

Albumen, a vegetable product; a form of proteine.

Albuminous (seeds): furnished with albumen, as the seeds of Indian corn, of Buckwheat, etc.

Alburnum: young wood, sap-wood.

Alpine: belonging to high mountains above the limit of forests.

Alternate (leaves): one after another. Petals are *alternate with* the sepals, or stamens with the petals, when they stand over the intervals between them.

Alveolate: honey-comb-like, as the receptacle of the Cotton-Thistle.

Ament: a catkin. *Amentaceous:* Catkin-like, or catkin-bearing.

Amorpheus: shapeless; without any definite form.

Amphigastrium (plural *amphigastria*); a peculiar stipule-like leaf of certain Liverworts.

Amphitropous or *Amphitropal* ovules or seeds.

Amplectant: embracing. *Amplexicaul* (leaves): clasping the stem by the base.

Ampullaceous: swelling out like a bottle or bladder.

Amylaceous: composed of starch, or starch-like.

Anantherous: without anthers *Ananthous:* destitute of flowers; flowerless.

Anastomosing: forming a net-work (*anastomosis*), as the veins of leaves.

Anatropous or *Anatropal* ovules or seeds

Ancipital (*anceps*) : two-edged, as the stem of Blue-eyed Grass.

Andrœcium: a name for the stamens taken together.

Androgynous: having both staminate and pistillate flowers in the same cluster or inflorescence, as many species of Carex.

Androphore: a column of united stamens, as in a Mallow; or the support on which stamens are raised.

Anfractuose: bent hither and thither, as the anthers of the squash, etc.

Angiospermæ, *Angiospermous Plants:* with their seeds formed in an ovary or pericarp.

Angular, *divergence* of leaves.

Annual (p'ant) : flowering and fruiting the year it is raised from the seed, and then dying.

Annular: in the form of a ring, or forming a circle.

Annulate: marked by rings or furnished with an

Annulus, or ring, like that of the spore-case of most Ferns; in Mosses it is a ring of cells placed between the mouth of the spore-case and the lid, in many species.

Anterior, in the blossom, is the part next the bract, i. e. external :—while the posterior side is that next the axis of inflorescence. Thus, in the Pea, etc., the keel is *anterior*, and the standard *posterior*.

Anther: the essential part of the stamen, which contains the pollen.

Antheridium: (plural *antheridia*) : the organ in Mosses, etc. which answers to the anther of Flowering Plants.

Antheriferous: anther-bearing.

Anthesis: the period or the act of the expansion of a flower.

Anthocarpous (fruits); same as multiple fruits.

Anticous: same as anterior

Antrorse; directed upwards or forwards.

Apetalous: destitute of petals.

Aphyllous: destitute of leaves, at least of foliage.

Apical: belonging to the apex or point.

Apiculate: pointletted; tipped with a short and abrupt point.

Apocarpous (pistils) : when the several pistils of the same flower are separate, as in a Buttercup, Sedum, etc.

Apophysis: any irregular swelling; the enlargement at the base of the spore-case of the Umbrella-Moss.

Appendage: any superadded part.

Appendiculate: provided with appendages.

Appressed: where branches are close pressed to the stem, or leaves to branch, etc.

Apterous: wingless.

Aquatic: living or growing in water; applied to plants, whether growing under water, or with all but the base raised out of it.

Arachnoid: cobwebby; clothed with, or consisting of soft downy fibres.

Arboreous Arborescent: tree-like in size or form.

Archegonium (plural *archegonia*): the organ in Mosses, etc., which is analogous to the pistil of Flowering Plants.

Arcuate: bent or curved like a bow.

Areolate: marked out into little spaces or *areolæ.*

Arillate (seeds) furnished with an

Aril or *Arillus:* a fleshy growth forming a false coat or appendage to a seed.

Aristate: awned, i. e. furnished with an arista, like the beard of Barley, etc

Aristulate: diminutive of the last; short-awned.

Arrow-shaped or *Arrow-headed:* same as *sagittate.*

Articulated: jointed; furnished with joints or *articulations* where it separates or inclines to do so.

Aspergilliform: shaped like the brush used to sprinkle holy wate; as the stigmas of many Grasses.

Assurgent: same as ascending.

Atropous or *Atropal* (ovules): same as orthotropous.

Auriculate: furnished with auricles, or ear-like appendages.

Awl-shaped: sharp-pointed from a broader base.

Awn: the bristle or beard of Barley, Oats, etc; or any similar bristle-like appendage.

Awned: furnished with an awn or long bristle-shaped tip.

Axil: the angle on the upper side between a leaf and the stem.

Axile: belonging to the axis or occupying the axis.

Axillary: (buds, etc.): occurring in an axil.

Axis: the central line of any body; the organ round which others are attached; the root and stem.

Baccate: berry-like, of a pulpy nature like a berry (in Latin *bacca.*)

Barbate: bearded; bearing tufts, spots, or lines of hairs.

Barbed: furnished with a *barb* or double hook; as the apex of the bristle on the fruit of Echinospermum (Stickseed), etc.

Barbellate: said of the bristles of the pappus of some Compositæ (species of Liatris, etc.), when beset with short, stiff hairs, longer than when denticulate, but shorter than when plumose.

Barbellulate: diminutive of barbellate.

Bark: the covering of a stem outside of the wood.

Basal: belonging or attached to the

Base: that extremity of any organ by which it is attached to its support.

Beaked: ending in a prolonged, narrow tip.

Bearded: see *barbate*. *Beard* is sometimes used popularly for awn, more commonly for long or stiff hairs of any sort.

Bell-shaped: of the shape of a bell, as the corolla of Harebell.

Berry: a fruit pulpy or juicy throughout, as a grape.

Bi, (or *Bis*), in compound words: twice; as

Biarticulate: twice-jointed, or two-jointed; separating into two pieces.

Biauriculate: having two ears.

Bicallose: having two callosities or harder spots.

Bicarinate: two-keeled, as the upper palea of Grasses.

Bicipital (*Biceps*): two-headed; dividing into two parts at the top or bottom.

Biconjugate: twice-paired, as when a petiole forks twice.

Bidentate: having two teeth (not twice or doubly dentate.)

Biennial: of two years' continuance; springing from the seed one season, flowering and dying the next.

Bifarious: two-ranked; arranged in two rows.

Bifid: two-cleft to about the middle, as the petals of Mouse-ear Chickweed.

Bifoliolate: a compound leaf of two leaflets.

Bifurcate: twice forked; or, more commonly forked into two, branches.

Bijugate: bearing two pairs (of leaflets, etc.)

Bilabiate: two-lipped, as the corolla of sage, etc.

Bilamellate: of two plates (*lamellæ*), as the stigma of Mimulus.

Bilobed: the same as two-lobed.

Bilocular: two-celled; as most anthers, the pod of Foxglove, most Saxifrages.

Binate: in couples, two together.

Bipartite: the Latin form of two-parted.

Bipinnate (leaf); twice pinnate.

Bipinnatifid: twice pinnatifid; that is, pinnatifid with the lobes again pinnatifid.

Biplicate: twice folded together.

Biserial, or *Biseriate:* occupying two rows, one within the other.

Biserrate: doubly serrate, as when the teeth of a leaf, etc., are themselves serrate.

Biternate: twice ternate; i. e., principal divisions three, each bearing three leaflets, etc.

Bladdery: thin and inflated, like the calyx of Silene inflata.

Blade of a leaf: its expanded portion.

Boat-shaped: concave within and keeled without, in shape like a small boat.

Brachiate: with opposite branches at right angles to each other, as in the Maple and Lilac.

Bract (Latin, *bractea*). Bracts, in general, are the leaves of an inflorescence, more or less different from ordinary leaves. Specially, the bract is the small leaf or scale from the axil of which a flower or its pedicel proceeds; and a

Bractlet (*bracteola*) is a bract seated *on* the pedicel or flower-stalk.

Bristles: stiff, sharp hairs, or any very slender bodies of similar appearance.

Bristly: beset with bristles.

Brush-shaped: see *aspergilliform.*

Bryology: that part of botany which relates to Mosses.

Bud: a branch in its earliest or undeveloped state.

Bulb: a leaf-bud with fleshy scales, usually subterranean.

Bulbiferous: bearing or producing bulbs.

Bulbose or *bulbous:* bulb-like in shape, etc.

Bulblets: small bulbs, born above ground, as on the stems of the bulb-bearing Lily and on the fronds of Cistopteris bulbifera and some other Ferns.

Bullate: appearing as if blistered or bladdery (from *bulla*, a bubble).

Caducous: dropping off very early, compared with other parts; as the calyx in the Poppy Family, falling when the flower opens.

Cæspitose, or *Cespitose:* growing in turf-like patches or tufts, like most sedges, etc.

Calcarate; furnished with a spur (*calcar*), as the flower of Larkspur and Violet.

Calceolate or *Calceiform:* slipper-shaped, like one petal of the Lady's Slipper.

Callose: hardened; or furnished with callosities or thickened spots.

Calycine: belonging to the calyx.

Calyculate: furnished with an outer accessory calyx (*calyculus*) or set of bracts looking like a calyx, as in true Pinks.

Calyptra: the hood or veil of the capsule of a Moss.

Calyptriform: shaped like a calyptra or candle-extinguisher.

Calyx: the outer set of the floral envelopes or leaves of the flower.

Campanulate: bell-shaped.

Campylotropous or *Campylotropal:* curved ovules and seeds of a particular sort.

Campylospermous: applied to fruits of Umbelliferæ when the seed is curved in at the edges, forming a groove down the inner face; as in Sweet Cicely.

Canaliculate: channeled, or with a deep longitudinal groove.

Cancellate: latticed, resembling lattice-work.

Canescent: grayish-white; hoary, usually because the surface is covered with fine white hairs. *Incanous* is whiter still.

Capillaceous, *Capillary:* hair-like in shape; as fine as hair or slender bristles.

Capitate: having a globular apex, like the head of a pin; as the stigma of Cherry; or forming a head like the flower-cluster of Button-bush.

Capitellate: diminutive of capitate.

Capitulum (a little head): a close rounded dense cluster or head of sessile flowers.

Capreolate: bearing tendrils (from *capreolus*, a tendril).

Capsule: a pod; any dry dehiscent seed-vessel.

Capsular: relating to, or like a capsule.

Carina: a keel; the two anterior petals of a papilionaceous flower, which are combined to form a body shaped somewhat like the keel (or rather the prow) of a vessel.

Carinate: keeled; furnished with a sharp ridge or projection on the lower side.

Cariopsis, or *Caryopsis:* the one-seeded fruit or grain of Grasses, etc.

Carneous: flesh-colored; pale red.

Carnose: fleshy in texture.

Carpel, or *carpidium:* a simple pistil, or one of the parts or leaves of which a compound pistil is composed.

Carpellary: pertaining to a carpel.

Carpology: that department of Botany which relates to fruits.

Carpophore: the stalk or support of a fruit or pistil within the flower.

Cartilaginous, or *Cartilagineous:* firm and tough like cartilage in texture.

Caruncle: an excrescence at the scar of some seeds; as those of Polygala.

Carunculate: furnished with a caruncle.

Caryophyllaceous: pink-like: applied to a corolla of five long-clawed petals.

Catkin: a scaly, deciduous spike of flowers, an ament.

Caudate: tailed or tail-pointed.

Caudex: a sort of trunk, such as that of Palms; an upright rootstock.

Caulescent: having an obvious stem.

Caulicle: a little stem or rudimentary stem.

Cauline: of or belonging to a stem (*caulis*, in Latin).

Cell (diminutive *Cellule*); the cavity of an anther, ovary, etc; one of the elements or vesicles of which plants are composed.

Centrifugal (inflorescence): produced or expanding in succession from the center outwards. The radicle is centrifugal, when it points away from the center of the fruit.

Centripetal: the opposite of centrifugal.

Cereal: belonging to corn, or corn-plants.

Cernuous: nodding; the summit more or less inclining.

Chaff: small membraneous scales or bracts on the receptacle of Compositæ; the glumes, etc., of Grasses.

Chaffy: furnished with chaff, or of the texture of chaff.

Chalaza: that part of the ovule where all the parts grow together.

Channelled: hollowed out like a gutter; same as *canalicolate.*

Character: a phrase expressing the essential marks of a species, genus, etc., which distinguish it from all others.

Chartaceous: of the texture of paper or parchment.

Chlorophyll: the green grains in the cells of the leaf, and of other parts exposed to the light, which give to herbage its green color.

Chromule: coloring matter in plants, especially when not green, or when liquid.

Cicatrix: the scar left by the fall of a leaf or other organ.

Ciliate: beset on the margin with a fringe of *cilia,* i. e. of hairs or bristles, like the eyelashes fringing the eyelids, whence the name.

Cinereous, or *Cineraceous:* ash-grayish; of the color of ashes.

Circinate: rolled inwards from the top, like a crosier, as the shoots of Ferns; the flower-clusters of Heliotrope, etc.

Circumscissile, or *Circumcissile:* divided by a circular line round the sides, as the pods of Purslane, Plantain, etc.

Circumscription: the general outline of a thing.

Cirrhiferous, or *Cirrhose:* furnished with a tendril (Latin, *cirrhus*); as the Grape vine. *Cirrhose* also means resembling or coiling like tendrils, as the leaf-stalks of Virgin's-bower.

Clathrate: latticed; same as *cancellate.*

Clavate: club-shaped; slender below and thickened upwards.

Claw: the narrow or stalk-like base of some petals, as of Pinks.

Climbing: rising by clinging to other objects.

Club-shaped: see *clavate.*

Clustered: leaves, flowers, etc. aggregated or collected into a bunch.

Clypeate: buckle-shaped.

Coadunate: same as *connate:* i. e. united.

Coalescent: growing together.

Coarctate: contracted or brought close together.

Cobwebby: same as *arachnoid;* bearing hairs like cobwebs or gossamer.

Coccus (plural *cocci*): anciently a berry; now mostly used to denote the carpels of a dry fruit which are separable from each other, as of Euphorbia.

Cochleariform: spoon-shaped.

Cochleat: coiled, or shaped like a snail-shell.

Cœlospermous: applies to those fruits of Umbelliferæ which have the seed hollowed on the inner face, by the curving inwards of the top and bottom, as in Coriander.

Coherent in Botany is usually the same as *connate*.
Collum or *Collar:* the neck or line of junction between the stem and the root.
Columella: the axis to which the carpels of a compound pistil are often attached, as in Geranium, or which is left when a pod opens, as in Azalea and Rhododendron.
Column: the united stamens, as in Mallow, or the stamens and pistils united into one body, as in the Orchis family.
Columnar: shaped like a column or pillar.
Coma: a tuft of any sort (literally, a head of hair).
Comose: tufted; bearing a tuft of hairs, as the seeds of Milkweed.
Commissure: the line of junction of two carpels, as in the fruit of Umbelliferæ, such as parsnip, Caraway, etc.
Common: used as "general," in contradistinction to "partial"; e. g. "common involucre."
Complanate. flattened.
Complicate: folded upon itself.
Compressed: flattened on two opposite sides.
Conduplicate: folded upon itself lengthwise, as the leaves of Magnolia in the bud.
Cone: the fruit of the Pine family.
Confluent: blended together; or the same as *coherent*.
Conformed: similar to another thing it is associated with or compared to; or closely fitted to it, as the skin to the kernel of a seed.
Congested, *Conglomerate:* crowded together.
Conjugate: coupled; in single pairs.
Connate: united or grown together from the first.
Connective, *Connectivum:* the part of the anther connecting its two cells.
Connivent: converging, or brought close together.
Continuous: the reverse of interrupted or articulated.
Contorted: twisted together. *Contorted æstivation:* same as *convolute*.
Contortupacate: twisted back upon itself.
Contracted: either narrowed or shortened.
Contrary: turned in an opposite direction to another organ or part with which it is compared.
Convolute: rolled up lengthwise, as the leaves of the Plum in vernation. In æstivation, same as *contorted*.
Cordate: heart-shaped.
Coriaceous: resembling leather in texture.
Corky: of the texture of cork.
Corm, *Cormus:* a solid bulb, like that of Crocus.
Corneous: of the consistence or appearance of horn, as the albumen of the seed of the Date, Coffee, etc.
Corniculate: furnished with a small horn or spur.

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Cornute: horned; bearing a horn-like projection or appendage.
Corolla: the leaves of the flower within the calyx.
Corollaceous, *Corolline:* like or belonging to a corolla.
Corona: a coronet or crown; an appendage at the top of the claw of some petals, as Silene and Soapwort, or of the tube of the corolla of Hound's-Tongue, etc.
Coronate: crowned; furnished with a crown.
Cortical: belonging to the bark (*cortex.*)
Corymb: a sort of flat or convex flower-cluster.
Corymbose: approaching the form of a corymb, or branched in that way; arranged in corymbs.
Costa: a rib; the midrib of a leaf, etc. *Costate:* ribbed.
Cotyledons: the first leaves of the embryo.
Crateriform: goblet-shaped; broadly cup-shaped.
Creeping (stems): growing flat on or beneath the ground and rooting.
Cremocarp: a half-fruit, or one of the two carpels of Umbelliferæ.
Crenate, or *Crenelled:* the edge scalloped into rounded teeth.
Crested, or *Cristate:* bearing any elevated appendage like a crest.
Cribrose: pierced like a sieve with small apertures.
Crinite: bearded with long hairs, etc.
Crown: see *corona.*
Crowning: borne on the apex of anything.
Cruciate, or *Cruciform:* cross-shaped, as the four spreading petals of the Mustard, and all the flowers of that family.
Crustaceous: hard, and brittle in texture; crust-like.
Crytogamous, or *Cryptogamic:* relating to Crytogamia.
Cucullate: hooded, or hood-shaped, rolled up like a cornet of paper, or a hood (*cucullus*), as the spathe of Indian Turnip.
Culm: a straw; the stem of Grasses and Sedges.
Cuneate, *Cuneiform:* wedge-shaped.
Cup-shaped: same as cyathiform, or near it.
Cupule: a little cup; the cup to the acorn of the Oak.
Cupulate: provided with a cupule.
Cuspidate: tipped with a sharp and stiff point.
Cut: same as incised, or applied generally to any sharp and deep division.
Cuticle: the skin of plants, or more strictly its external pellicle.
Cyathiform: in the shape of a cup, or particularly of a wine-glass.
Cycle: one complete turn of a spire, or a circle.
Cyclical: rolled up circularly, or coiled into a complete circle.
Cyclosis: the circulation in closed cells.
Cylindraceous: approaching to the
Cylindrical form; as that of stems, etc., which are round, and gradually if at all tapering.

Cymbæform, or *Cymbiform:* same as boat-shaped.
Cyme: a cluster of centrifugal inflorescence.
Cymose: furnished with cymes, or like a cyme.

Deca- (in composition of words of Greek derivation): ten; as
Decagynous: with 10 pistils or styles. *Decandrous:* with 10 stamens.
Deciduous: falling off, or subject to fall, said of leaves which fall in autumn, and of a calyx and corolla which fall before the fruit forms.
Declined: turned to one side, or downwards, as the stamens of Azalea nudiflora.
Decompound: several times compounded or divided.
Decumbent: reclined on the ground, the summit tending to rise.
Decurrent (leaves): prolonged on the stem beneath the insertion, as in Thistles.
Decussate: arranged in pairs which successively cross each other.
Definite: when of a uniform number, and not above twelve or so.
Deflexed: bent downwards.
Deflorate: past the flowering state, as an anther after it has discharged its pollen.
Dehiscence: the mode in which an anther or a pod regularly bursts or splits open.
Dehiscent: opening by regular dehiscence.
Deliquescent: branching off so that the stem is lost in the branches.
Deltoid: of a triangular shape.
Demersed: growing below the surface of water.
Dendroid, *Dendritic:* tree-like in form or appearance.
Dentate: toothed (from the Latin *dens*, a tooth.)
Denticulate: furnished with denticulations, or very small teeth: diminutive of the last.
Depauperate: impoverished or starved.
Depressed: flattened, or as if pressed down from above; flattened vertically.
Descending: tending gradually downwards.
Dextrose: turned to the right hand.
Di- (in Greek compounds): two as
Diadelphous (stamens): united by their filaments in two sets.
Diandrous: having two stamens.
Diagnosis: a short distinguishing character, or descriptive phrase.
Diaphanous: transparent or translucent.
Dichlamydeous (flower): having both calyx and corolla.
Dichotomons: two-forked.
Diclinous: having the stamens in one flower, the pistils in another.
Dicoccous (fruit): splitting into two *cocci* or closed carpels.
Dicotyledonous (embryo): having a pair of cotyledons.

Didymous: twin.
Didynamous (stamens); having four stamens in two pairs, one pair shorter than the other.
Diffuse: spreading widely and irregularly.
Digitate (fingered): where the leaflets of a compound leaf are all borne on the apex of the petiole.
Digynous (flower): having two pistils or styles.
Dimerous: made up of two parts, or its organs in twos.
Dimidiate: halved; or where a leaf or leaflet has only one side developed, or a stamen has only one lobe or cell.
Dimorphous: of two forms.
Diœcious or *Dioicous:* where the stamens and pistils are in separate flowers on different plants.
Dipetalous: of two petals. *Diphyllous:* two-leaved. *Dipterous:* two-winged.
Disciform or *Disk-shaped:* flat and circular, like a disk or quoit,
Disk: the face of any flat body; the central part of a head of flowers, like the Sunflower, or Coreopsis, as opposed to the *ray* or margin; a fleshy expansion of the receptacle of a flower.
Dissected: cut deeply into many lobes or divisions.
Dissepiments: the partitions of an ovary or a fruit.
Distichous: two-ranked.
Distinct: uncombined with each other.
Divaricate: straddling; very widely divergent.
Divided (leaves, etc.): cut into divisions extending about to the base or the mid rib.
Dodeca- (in Greek compounds): twelve; as
Dodecagynous: with twelve pistils or styles.
Dodecandrous: with twelve stamens.
Dolabriform: axe-shaped.
Dorsal: pertaining to the back (*dorsum*) of an organ.
Double Flowers, so called: where the petals are multiplied unduly.
Downy: clothed with a coat of soft and short hairs.
Drupe: a stone-fruit.
Drupaceous: like or pertaining to a drupe.
Ducts: the so-called vessels of plants.
Dumose: bushy, or relating to bushes.
Duramen: the heart-wood.
Dwarf: remarkably low in stature.
E-, or *Ex-*, at the beginning of compound words, means destitute of; as *ecostate*, without a rib or midrib; *exalbuminous*, without albumen, etc.
Eared: see *auriculate*.
Ebracteate: destitute of bracts.

Echinate: armed with prickles (like a hedgehog). *Echinulate:* a diminutive of it.

Edentate: toothless.

Effete: past bearing, etc.; said of anthers which have discharged their pollen.

Eglandulose: destitute of glands

Elaters: threads mixed with the spores of Liverworts.

Ellipsoidal: approaching an elliptical figure.

Elliptical: oval or oblong, with the ends regularly rounded.

Emarginate: notched at the summit.

Embryo: the rudimentary undeveloped plantlet in a seed.

Emersed: raised out of water.

Endecagynous: with eleven pistils or styles. *Endecandrous;* with eleven stamens.

Endocarp: the inner layer of a pericarp or fruit

Endochrome: the coloring matter of Algæ and the like.

Endosperm: another name for the albumen of a seed.

Endostome: the orifice in the inner coat of an ovule.

Ennea-: nine. *Enneagynous:* with nine petals or styles

Enneandrous: with nine stamens.

Ensiform: sword-shaped; as the leaves of Iris.

Entire: the margins not at all toothed, notched, or divided, but even.

Ephemeral: lasting for a day or less, as the corolla of Purslane, etc.

Epi-, in composition upon: as

Epicarp: the outermost layer of a fruit.

Epidermal: relating to the *Epidermis*, or the skin of a plant.

Epigœous: growing on the earth or close to the ground.

Epigynous: upon the ovary.

Epipetalous: borne on the petals or the corolla.

Epiphyllous: borne on a leaf.

Epiphyte: a plant growing on another plant, but not nourished by it.

Epiphytic or *Epiphytal:* relating to *Epiphytes.*

Episperm: the skin or coat of a seed, especially the outer coat.

Equal: same as *regular;* or of the same number or length, as the case may be of the body it is compared with.

Equally pinnate: same as abruptly pinnate.

Equitant (riding straddle).

Erose: eroded, as if gnawed.

Erostrate: not beaked.

Estivation: see *Aestivation.*

Etiolated: blanched by excluding the light, as the stalks of Celery.

Evergreen: holding the leaves over winter and until new ones appear, or longer.

Exalbuminous (seed): destitute of albumen.

Excurrent: running out, as when a midrib projects beyond the apex of a leaf, or a trunk is continued to the very top of a tree.

Exostone: the orifice in the outer coat of the ovule.

Explanate: spread or flattened out.

Exserted: protruding out of.

Exstipulate: destitute of stipules.

Extra-axillary: said of a branch or bud a little out of the axil.

Extrorse: turned outwards; the anther is extrorse when fastened to the filament on the side next the pistil, and opening on the outer side.

Falcate: scythe shaped; a flat body curved, its edges parallel.

Farinaceous: mealy in texture. *Farinose:* covered with a mealy powder.

Fasciate: banded; also applied to monstrous stems which grow flat.

Fascicle: a close cluster.

Fascicled, Fasciculated: growing in a bundle or tuft.

Fastigiate: close, parallel, and upright, as the branches of Lombardy Poplar.

Faux, (plural, *fauces*): the throat of a calyx, corolla, etc.

Faveolate, Favose: honeycombed; same as *alveolate.*

Feather-veined: where the veins of a leaf spring from along the sides of a mid rib.

Female (flowers): with pistils and no stamens.

Fenestrate: pierced with one or more large holes, like windows.

Ferrugineous, or *Ferruginous:* resembling iron rust; red-grayish.

Fertile: fruit-bearing, or capable of producing fruit; also said of anthers when they produce good pollen.

Fertilization: the process by which pollen causes the embryo to be formed.

Fibre, Fibrous: containing much fibre, or composed of fibres.

Fibrillose: composed of small fibres.

Fiddle-shaped: obovate with a deep recess on each side.

Filament: the stalk of a stamen; also any slender thread-shaped appendage.

Filamentose, or *Filamentous:* bearing or formed of slender threads.

Filiform: thread-shaped; long slender and cylindrical.

Fimbriate: fringed; furnished with fringes (*fimbriæ*).

Fistular or *fistulose:* hollow and cylindrical, as the leaves of the Onion.

Flabelliform or *Flabellate:* fan-shaped; broad, rounded at the summit, and narrow at the base.

Flagellate, or *Flagelliform:* long, narrow and flexible, like the thong of a whip or like the runners (*flagellæ*) of the Strawberry.

Flavescent: yellowish, or turning yellow.

Fleshy: composed of firm pulp or flesh.

Flexuose, or *Flexuous:* bending gently in opposite directions, in a zig-zag way.

Floating: swimming on the surface of water.
Floccose: composed, or bearing tufts, of wooly or long and soft hairs.
Flora (the goddess of flowers): the plants of a country or district taken together, or a work systematically describing them.
Floral: relating to the blossom.
Floral Envelopes: the leaves of the flower.
Floret: a diminutive flower; one of the flowers of a head (or of the so-called compound flower) of Compositæ.
Flower: the whole organs of reproduction of Phænogamous plants.
Flower-bud: an unopened flower.
Foliaceous: belonging to, or of the texture or nature of a leaf (*folium*).
Foliose: leafy; abounding in leaves.
Foliolate: relating to or bearing leaflets (*foliola*).
Follicle: a simple pod, opening down the inner suture.
Follicular: resembling or belonging to a follicle.
Foramen: a hole or orifice, as that of the ovule.
Fornix: little arched scales in the throat of some corollas, as of Comfrey.
Fornicate: over-arched or arching over.
Foveate: deeply pitted. *Foveolate:* diminutive of *foveate*.
Free: not united with any other parts of a different sort.
Fringed: the margin beset with slender appendages, bristles, etc.
Frond: what answers to leaves in Ferns; the stem and leaves fused into one body, as in Duckweed and many Liverworts, etc.
Frondescence: the bursting into leaf.
Frondose: frond-bearing; like a frond; or sometimes used for leafy.
Fructification: the state of fruiting.
Fruit: the matured ovary and all it contains or is connected with.
Frutescent: somewhat shrubby; becoming a shrub (*frutex*).
Fruiticulose: like a small shrub. *Fruiticose;* shrubby.
Fugacious: soon falling off or perishing.
Fulvous: tawny; dull yellow with gray.
Funiculus: the stalk of a seed or ovule.
Funnel-form, or *Funnel-shaped:* expanding gradually upwards, like a funnel or tunnel.
Furcate: forked.
Furfuraceous: covered with bran-like fine scurf.
Furrowed: marked by longitudinal channels or grooves.
Fuscous: deep gray-brown.
Fusiform: spindle-shaped.

Galeate: shaped like a helmet (*galea*).
Gamopetalous: of united petals; same as *monopetalous*, and a better word.
Gamophyllous: formed of united leaves. *Gamosepalous:* formed of united sepals.

Geminate: twin; in pairs; as the flowers of Linnæa.
Gemma: a bud.
Gemmation: the state of budding, or the arrangement of parts in the bud.
Gemmule: a small bud; the buds of Mosses the plumule.
Geniculate: bent abruptly, like a knee (*genu*), as many stems.
Genus: a kind; a rank above species.
Geographical Botany: the study of plants in their geographical relations.
Germ: a growing point; a young bud; sometimes the same as embryo.
Germen: the old name for ovary.
Germination: the development of a plantlet from the seed.
Gibbous: more tumid at one place or on one side than the other.
Glabrate: becoming glabrous with age, or almost glabrous.
Glabrous: smooth, i e., having no hairs, bristles, or other pubescence.
Gladiate: sword-shaped.

Glands: small cellular organs which secrete oily or aromatic or other products; they are sometimes sunk in the leaves or rind, as in the Orange, Prickly Ash, etc.; sometimes on the surface as small projections; sometimes raised on hairs or bristles (*glandular hairs, etc.*), as in the Sweetbrier and Sundew. The name is also given to any small swellings, etc., whether they secrete anything or not.

Glandular, *Glandulose:* furnished with glands, or gland-like.
Glans (*Gland*): the acorn or mast of Oak and similar fruits.
Glaucescent: slightly glaucous, or bluish-gray.
Glaucous: covered with a *bloom*, viz., with a fine white powder that rubs off, like that on a fresh plum, or a cabbage leaf.
Globose: spherical in form, or nearly so. *Globular:* nearly globose.
Glochidiate (hairs or bristles): barbed; tipped with barbs, or with a double hooked point.
Glomerate: closely aggregated into a dense cluster.
Glomerule: a dense head-like cluster.
Glossology: the department of Botany in which technical terms are explained.
Glumaceous: glume-like, or glume-bearing.
Glume: Glumes are the husks or floral coverings of Grasses, or, particularly, the outer husks or bracts of each spikelet.
Glumelles: the inner husks, or paleæ, of Grasses.
Gluten: a vegetable product containing nitrogen.
Granular: composed of grains. *Granule:* a small grain.
Grumous or Grumose: formed of coarse clustered grains.
Guttate: spotted, as if by drops of something colored.
Gymnocarpous: naked-fruited.
Gymnospermous: naked-seeded.
Gynandrous: with stamens borne on, i. e., united with, the pistil.
Gynæcium: a name for the pistils of a flower taken altogether.

Gynobase: a particular receptacle or support of the pistils, or of the carpels of a compound ovary, as in Geranium.
Gynophore: a stalk raising a pistil above the stamens.
Gyrate: coiled in a circle; same as *circinate*.
Gyrose: strongly bent to and fro.

Habit: the general aspect of a plant, or its mode of growth.
Habitat: the situation in which a plant grows in a wild state.
Hairs: hair-like projections or appendages of the surface of plants.
Hairy: beset with hairs, especially longish one.
Halberd-shaped, or *Halberd-headed:* see *hastate*.
Halved: when appearing as if one-half of the body were cut away.
Hamate, or *Hamose:* hooked; the end of a slender body bent round.
Hamulŏse: bearing a small hook; a diminutive of the last.
Hastate, *Hastile:* shaped like a Halberd; furnished with a spreading lobe on each side at the base.
Heart-shaped: of the shape of a heart as commonly painted.
Heart-wood: the older or matured wood of exogenous trees.
Helicoid: coiled like a *helix* or snail-shell.
Helmet: the upper sepal of Monkshood in this shape.
Hemi- (in compounds from the Greek): half; e g. *Hemispherical*, etc.
Hemicarp: half-fruit, or one carpel of an Umbelliferous plant.
Hemitropous or *hemitropal:* (ovular seed) nearly same as amphitropous.
Hepta (in words of Greek origin): seven, as
Heptagynous: with seven pistils or styles.
Heptamerous: its parts in sevens. *Heptandrous:* having seven stamens.
Herbaceous: of the texture of common herbage; not woody.
Herbarium: the botanist's arranged collection of dried plants.
Hermaphrodite (flower): having both stamens and pistils in the same blossom; same as *perfect*.
Heterocarpous: bearing fruit of two sorts or shapes, as in Amphicarpæa.
Heterogamous: bearing two or more sorts of flowers as to their stamens and pistils; as in Aster, Daisy, and Coreopsis.
Heteromorphous: of two or more shapes.
Heterotropous, or *Heterotropal* (ovule): the same as *amphitropous*.
Hexa- (in Greek compounds): six; as
Hexagonal: six-angled. *Hexagynous:* with six pistils or styles.
Hexamerous: its parts in sixes. *Hexandrous:* with six stamens.
Hexapterous: six-winged.
Hilar: belonging to the hilum.
Hilum: the scar of the seed; its place of attachment.
Hippocrepiform: horseshoe-shaped.
Hirsute: hairy with stiffish or beard-like hairs.
Hispid: bristly; beset with stiff hairs. *Hispidulous* is a diminutive of it.

Hoary: grayish-white; see *canescent*, etc.
Homogamous: a head or cluster with flowers all of one kind, as in Eupatorium.
Homogeneous: uniform in nature; all of one kind.
Homomallous (leaves, etc.): originating all round a stem, but all bent or curved round to one side.
Homomorphous: all of one shape.
Homotropous or *Homotropal* (embryo): curved with the seed; curved one way.
Hood: same as *helmet* or *galea.* *Hooded:* hood-shaped, see *cucullate.*
Hooked: same as *hamate.*
Horn: a spur or some similar appendage. *Horny:* of the texture of horn.
Hortus Siccus: an herbarium, or collection of dried plants.
Humifuse: spread over the surface of the ground.
Hyaline: transparent, or partly so.
Hybrid: a cross-breed between two allied species.
Hypocrateriform: salver-shaped.
Hypogœan: produced under ground.
Hypogynous: inserted under the pistil.

Icosandrous: having 12 or more stamens inserted on the calyx.
Imbricate, *Imbricated*, *Imbricative:* overlapping one another, like tiles or shingles on a roof, as the scales of the involucre of Zinnia, etc., or the bud-scales of Horsechestnut and Hickory. In æstivation, where some leaves of the calyx or corolla are overlapped on both sides by others.
Immarginate: destitute of a rim or a border.
Immersed: growing wholly under water.
Impari-pinnate: pinnate with a single leaflet at the apex.
Imperfect flowers: wanting either stamens or pistils.
Inœquilateral: unequal-sided, as the leaf of a Begonia.
Incanous: hoary with white pubescence.
Incised: cut rather deeply and irregularly.
Included: enclosed; when the part in question does not project beyond another.
Incomplete Flower: wanting calyx or corolla.
Incrassated: thickened.
Incumbent: leaning or resting upon: the cotyledons are incumbent when the back of one of them lies against the radicle; the anthers are incumbent when turned or looking inwards.
Incurved: gradually curving inwards.
Indefinite: not uniform in number, or too numerous to mention.
Indehiscent: not splitting open; i. e. not dehiscent.
Indigenous: native to the country.

Induplicate: with the edges turned inwards.
Indusium: the shield or covering of a fruit-dot of a Fern.
Inferior: growing below some other organ.
Inflated: turgid and bladdery.
Inflexed: bent inwards.
Inflorescence: the arrangement of flowers on the stem.
Infra-axillary: situated beneath the axil.
Infundibuliform or *Infundibular:* funnel-shaped.
Innate (anther): attached by its base to the very apex of the filament.
Innovation: in incomplete young shoot, especially in Mosses.
Insertion: the place or the mode of attachment of an organ to its support.
Internode: the part of a stem between two nodes.
Interruptedly pinnate: pinnate with small leaflets intermixed with larger ones, as in Water Avens.
Intrafoliaceous (stipules, etc.); placed between the leaf or petiole and the stem
Introrse: turned or facing inwards, i. e. towards the axis of the flower.
Inverse or *Inverted:* where the apex is in the direction opposite to that of the organ it is compared with.
Involucel: a partial or small involucre.
Involucellate: furnished with an involucel.
Involucrate: furnished with an involucre.
Involucre: a whorl or set of bracts around a flower, umbel, or head.
Involute, in vernation: rolled inwards from the edges.

Jointed: separate or separable at one or more places into pieces.

Keel: a projecting ridge on a surface, like the keel of a boat; the two anterior petals of a papilionaceous corolla.
Keeled: furnished with a keel or sharp longitudinal ridge.
Kidney-shaped: resembling the outline of a kidney.

Labellum: the odd petal in the Orchis Family.
Labiate: same as *bilabiate* or two-lipped.
Laciniate: slashed; cut into deep narrow lobes (called *lacinæ*).
Lactescent: producing milky juice, as does the Milkweed, etc.
Lacunose: full of holes or gaps.
Lævigate: smooth as if polished.
Lamellar or *Lamellate:* consisting of flat plates (*lamellæ*).
Lamina: a plate or blade: the blade of a leaf, etc.
Lanate: woolly; clothed with long and soft entangled hairs.
Lanceolate: lance-shaped.
Lanuginous: cottony or woolly.
Latent buds; concealed or undeveloped buds.

Lateral: belonging to the side.
Latex: the milky juice, etc., of plants.
Lax: loose in texture, or sparse; the opposite of crowded.
Leaflet: one of the divisions or blades of a compound leaf.
Leaf-like: same as *foliaceous.*
Leathery: of about the consistence of leather; coriaceous.
Legume: a simple pod, dehiscent into two pieces, like that of the Pea! the fruit of the Pea Family (*Leguminosæ*), of whatever shape.
Leguminous: belonging to legumes, or the Leguminous Family.
Lenticular: lens-shaped; i. e. flattish and convex on both sides.
Lepidote: leprous; covered with scurfy scales.
Liber: the inner, fibrous bark of Exogenous plants.
Ligneous, or *Lignose:* woody in texture.
Ligulate: furnished with a ligule.
Ligule: the strap-shaped corolla in many Compositæ, the little membranous appendage at the summit of the leaf-sheaths of most Grasses.
Limb: the blade of a leaf, petal, etc.
Linear: narrow and flat, the margins parallel.
Lineate: marked with parallel lines. *Lineolate:* marked with minute lines.
Lingulate, *Linguiform:* tongue-shaped.
Lip: the principal lobes of a bilabiate corolla or calyx; the odd and peculiar petal in the Orchis Family.
Lobe: any projection or division (especially a rounded one) of a leaf, etc.
Locellus (plural *locelli*): a small cell, or compartment of a cell, of an ovary or anther.
Locular: relating to the cell or compartment (*loculus*) of an ovary, etc.
Loculicidal (dehiscence): splitting down through the middle of the back of each cell.
Locusta: a name for the spikelet of Grasses.
Loment: a pod which separates transversely into joints.
Lomentaceous: pertaining to or resembling a loment.
Lorate: thong-shaped.
Lunate: crescent-shaped. *Lunulate:* diminutive of *lunate.*
Lyrate: lyre-shaped; a pinnatifid leaf of an obovate or spatulate outline, the end-lobe large and roundish, and the lower lobes small, as in Winter-Cress and Radish.

Mace: the aril of the Nutmeg.
Maculate: spotted or blotched.
Male (flowers): having stamens but no pistils.
Mammose: breast-shaped.
Marcescent: withering without falling off.
Marginal: belonging to the edge or margin.

Marginate: margined, with an edge different from the rest.
Masked: see *personate.*
Median: belonging to the middle.
Medullary: belonging to, or of the nature of pith *(medulla);* pithy.
Medullary Rays: the silver-grain of wood.
Medullary Sheath: a set of ducts just around the pith.
Membranaceous or *Membranous:* of the texture of membrane; thin and more or less translucent.
Meniscoid: crescent-shaped.
Mericarp: one carpel of the fruit of an Umbelliferous plant.
Merismatic: separating into parts by the formation of partitions within.
Mesocarp: the middle part of a pericarp, when that is distinguishable into three layers.
Mesophlœum: the middle or green bark.
Micropyle: the closed orifice of the seed.
Midrib: the middle or main rib of a leaf.
Miniate: vermilion-colored.
Mitriform: mitre-shaped; in the form of a peaked cap.
Monadelphous: stamens united by their filaments into one set.
Monandrous (flower): having only one stamen.
Moniliform: necklace-shaped; a cylindrical body contracted at intervals.
Monochlamydeous: having only one floral envelope, i. e. calyx, but no corolla, as anemone.
Monocotyledonous (embryo): with only one cotyledon.
Monœcious, or *Monoicous* (flower): having stamens or pistils only.
Monogynous (flower): having only one pistil, or one style.
Monopetalous (flower): with the corolla of one piece.
Monophyllous: one-leaved, or of one piece.
Monosepalous: a calyx of one piece; i. e., with the sepals united into one body.
Monospermous: one-seeded.
Monstrosity: an unnatural deviation from the usual structure or form.
Morphology: the department of botany which treats of the forms which an organ (say a leaf) may assume.
Mucronate: tipped with an abrupt short point *(mucro).*
Mucronulate: tipped with a minute abrupt point; a diminutive of the last.
Multi-, in composition: many; as
Multangular: many-angled. *Multicipital:* many-headed, etc.
Multifarious: in many rows or ranks. *Multifid:* many-cleft.
Multilocular: many-celled. *Multiserial:* in many rows.
Muricate: beset with short and hard points.
Muriform: wall-like; resembling courses of bricks in a wall.
Muscology: the part of descriptive botany which treats of Mosses (i. e. *Musci*).

Muticous: pointless; beardless; unarmed.

Mycelium: the spawn of Fungi; i. e. the filaments from which Mushrooms, etc., originate.

Napiform: turnip-shaped.

Naturalized: introduced from a foreign country, but growing perfectly wild and propagating freely by seed.

Navicular: boat-shaped, like the glumes of most Grasses.

Necklace-shaped: looking like a string of beads; see *moniliform.*

Nectar: the honey, etc., secreted by glands, or by any part of the corolla.

Nectariferous: honey-bearing; or having a nectary.

Nectary: the old name for petals and other parts of the flower when of unusual shape, especially when honey-bearing. So the hollow spur-shaped petals of Columbine were called nectaries.

Needle-shaped: long, slender, and rigid, like the leaves of Pines.

Nerve: a name for the ribs or veins of leaves, when simple and parallel.

Nerved: furnished with nerves, or simple and parallel ribs or veins.

Netted-veined: furnished with branching veins forming network.

Nodding (in Latin form, *Nutant*): bending so that the summit hangs downward.

Node: a knot; the "joints" of a stem, or the part whence a leaf or a pair of leaves springs.

Nodose: knotty or knobby. *Nodulose:* furnished with little knobs or knots.

Normal: according to rule; the pattern or natural way according to some law.

Notate: marked with spots or lines of a different color.

Nucamentaceous: relating to or resembling a small nut.

Nuciform: nut-shaped or nut-like. *Nucule:* a small nut.

Nucleus: the kernel of an ovule of a cell.

Nut: a hard, mostly one-seeded indehiscent fruit; as a chestnut, butternut, acorn.

Nutlet: a little nut; or the stone of a drupe.

Ob- (meaning over against): when prefixed to words, signifies inversion; as

Obcompressed: flattened the opposite of the usual way.

Obcordate: heart-shaped with the broad and notched end at the apex instead of the base.

Oblanceolate: lance-shaped with the tapering point downwards.

Oblique: applied to leaves, etc , means unequal-sided.

Oblong: from two to four times as long as broad, and more or less elliptical in outline.

Obovate: inversely ovate, the broad end upward.

Obtuse: blunt, or round at the end.

Obverse: same as *inverse.*

Obvolute (in the bud): when the margins of one leaf alternately overlap those of the opposite one.
Ochreate: furnished with *ochreæ* (boots), or stipules in the form of sheaths.
Ochroleucous: yellowish-white; dull cream-color.
Octo-, eight, enters into the composition of
Octagynous: with eight pistils or styles.
Octamerous: its parts in eights. *Octandrous:* with eight stamens, etc.
Offset: short branches next the ground which take root.
One-ribbed, *One-nerved*, *etc.:* furnished with only a single rib, etc., etc.
Opaque, applied to a surface, means dull, not shining.
Operculate: furnished with a lid or cover *(operculum)*, as the capsules of Mosses.
Opposite: said of leaves and branches when on opposite sides of the stem from each other (i. e. in pairs). Stamens are opposite the petals, etc., when they stand before them.
Orbicular, *Orbiculate:* circular in outline or nearly so.
Organ: any member of the plant, as a leaf, a stamen, etc.
Osseous: of a bony texture.
Oval: broadly elliptical.
Ovary: that part of the pistil containing the ovules or future seeds.
Ovate: shaped like an egg with the broader end downwards, or, in plane surfaces, such as leaves, like the section of an egg lengthwise.
Ovoid: ovate or oval in a solid form.
Ovule: the body which is destined to become a seed.

Palea (plural *paleæ*): chaff; the inner husks of Grasses.
Paleaceous: furnished with chaff, or chaffy in texture.
Palmate: when leaflets or the divisions of a leaf all spread from the apex of the petiole, like the hand with the outspread fingers.
Palmately (veined, lobed, etc.): in a palmate manner.
Panduriform: fiddle-shaped (which see.)
Panicle: an open cluster; like a raceme, but more or less compound.
Panicled, *Paniculate:* arranged in panicles, or like a panicle.
Papery: of about the consistence of letter-paper.
Papilionaceous: butterfly-shaped; applied to such a corolla as that of the Pea and the Locust-tree.
Papilla (plural *papillæ*): little nipple-shaped protuberances.
Papillate, *Papillose:* covered with papillæ.
Pappus: thistle-down. The down crowning the achenium of the Thistle, and other Compositæ, represents the calyx; so the scales, teeth, chaff, as well as bristles, or whatever takes the place of the calyx in this family, are called the pappus.
Paraphyses: jointed filaments mixed with the antheridia of Mosses.
Parenchyma: soft cellular tissue of plants, like the green pulp of leaves.

Parietal (placentæ, etc.): attached to the walls *(p–rietes)* of the ovary or pericarp.

Parted: separated or cleft into parts almost to the base.

Partial involucre, same as an *involucel; partial petiole*, a division of a main leaf stalk or the stalk of a leaflet; *partial peduncle*, a branch of a peduncle; *partial umbel*, an umbellet.

Patent: spreading; open. *Patulous:* moderately spreading.

Pauci-, in composition, few; as *pauciflorous*, few-flowered, etc.

Pear-shaped: solid obovate, the shape of a pear.

Pectinate: pinnatifid or pinnately divided into narrow and close divisions, like the teeth of a comb.

Pedate: like a bird's foot; palmate or palmately cleft, with the side divisions again cleft, as in Viola pedata, etc.

Pedately cleft, lobed, etc.: cut in a pedate way.

Pedicel: the stalk of each particular flower of a cluster.

Pedicellate, Pedicelled: furnished with a pedicel.

Peduncle: a flower-stalk, whether of a single flower or of a flower-cluster.

Peduncled, Pedunculate: furnished with a peduncle.

Peltate: shield-shaped; said of a leaf, whatever its shape, when the petiole is attached to the lower side, somewhere within the margin.

Pendent: hanging. *Pendulous:* somewhat hanging or drooping.

Penicillate: tipped with a tuft of fine hairs, like a painter's pencil; as the stigmas of some Grasses.

Penta- (in words of Greek composition): five; as

Pentagynous: with five pistils or styles.

Pentamerous: with its parts in fives, or on the plan of five.

Pentandrous: having five stamens. *Pentastichous:* in five ranks.

Pepo: a fruit like the Melon and Cucumber.

Perennial: lasting from year to year.

Perfect (flower): having both stamens and pistils.

Perfoliate: passing through the leaf, in appearance.

Perforate: pierced with holes, or with transparent dots resembling holes, as an Orange-leaf.

Perianth: the leaves of the flower generally, especially when we cannot readily distinguish them into calyx and corolla.

Pericarp: the ripened ovary; the walls of the fruit.

Pericarpic: belonging to the pericarp.

Perichæth: the cluster of peculiar leaves at the base of the fruit-stalk of Mosses.

Perichætial: belonging to the perichæth.

Perigonium, Perigone: same as *perianth.*

Perigynium: bodies around the pistil; applied to the closed cup or bottle-shaped body which encloses the ovary of Sedges, and to the bristles, little scales, etc., of the flowers of some other Cyperaceæ.

Perigynous: the petals and stamens borne on the calyx.

Peripheric: around the outside, or periphery, of an organ.

Perisperm: a name for the albumen of a seed.

Peristome: the fringe of teeth, etc., around the orifice of the capsule of Mosses.

Persistent: remaining beyond the period when such parts commonly fall, as the leaves of evergreens, and the calyx, etc., of such flowers as remain during the growth of the fruit.

Personate: masked; a bilabiate corolla with a projection, or *palate* in the throat, as of the Snapdragon.

Petal: a leaf of the corolla.

Petaloid: petal-like; resembling or colored like petals.

Petiole: a footstalk of a leaf.

Petioled, *Petiolate:* furnished with a petiole.

Petiolulate: said of a leaflet when raised on its own partial leafstalk.

Phænogamous, or *Phanerogamous:* plants bearing flowers and producing seeds; same as Flowering Plants.

Phyllodium (plural *phyllodia*): a leaf where the blade is a dilated petiole, as in New Holland Acacias.

Phyllotaxis, or *Phyllotaxy:* the arrangement of leaves on the stem.

Phyton: a name used to designate the pieces which by their repetition make up a plant, theoretically, viz., a joint of stem with its leaf or pair of leaves.

Piliferous: bearing a slender bristle or hair *(pilum)*, or beset with hairs.

Pilose: hairy; clothed with soft slender hairs.

Pinna: a primary branch of the petiole of a bipinnate or tripinnate leaf.

Pinnule: a secondary branch of the petiole of a bipinnate or tripinnate leaf.

Pinnate (leaf): when the leaflets are arranged along the sides of a common petiole.

Pinnatifid: same as pinnately cleft.

Pistil: the seed-bearing organ of the flower.

Pistillidium: the body which in Mosses, Liverworts, etc., answers to the pistil.

Pith: the cellular centre of an exogenous stem.

Pitted: having small depressions or pits on the surface, as many seeds.

Placenta: the surface or part of the ovary to which the ovules are attached.

Plane: flat, outspread.

Plumose: feathery; when any slender body (such as a bristle of a pappus) is beset with hairs along its sides, like the plumes or the beard on a feather.

Plumule: the little bud or first shoot of a germinating plantlet above the cotyledons.

Pluri-, in composition; many or several; as

Plurifoliolate: with several leaflets.

Pod: specially a legume; also applied to any sort of capsule.

Podosperm: the stalk of a seed.

Pointless: destitute of any pointed tip, such as a *mucro*, *awn*, *acumination*, *etc.*

Pollen: the fertilizing powder of the anther.

Pollen-mass: applied to the pollen when the grains all cohere into a mass, as in Milkweed and Orchis.

Poly- (in compound words of Greek origin): same as *multi-* in those of Latin origin, viz., many; as

Polyadelphous: having the stamens united by their filaments into several bundles.

Polyandrous: with numerous (more than 20) stamens (inserted on the receptacle).

Polycotyledonous: having many (more than two) cotyledons, as Pines.

Polygamous: having some perfect and some separated flowers, on the same or on different individuals, as the Red Maple.

Polygonal: many-angled.

Polygynous: with many pistils or styles.

Polymerous: formed of many parts of each set.

Polymorphous: of several or varying forms.

Polypetalous: when the petals are distinct or separate (whether few or many).

Polyphyllous: many-leaved; formed of several distinct pieces, as the calyx of Sedum.

Polysepalous: same as the last when applied to the calyx.

Polyspermous: many-seeded.

Pome: the apple, pear, and similar fleshy fruits.

Porous: full of holes or pores.

Pouch: the silicle or short pod, as of Shepherd's Purse.

Præfloration: same as *æstivation*.

Præfoliation: same as *vernation*.

Præmorse: ending abruptly, as if bitten off.

Prickles: sharp elevations of the bark, coming off with it, as of the Rose.

Prickly: bearing prickles, or sharp projections like them.

Primine: the outer coat of the covering of the ovule.

Primordial: earliest formed; primordial leaves are the first after the cotyledons.

Prismatic: prism-shaped; having three or more angles bounding flat or hollowed sides.

Process: any projection from the surface or edge of a body.

Procumbent: trailing on the ground.

Produced: extended or projecting, as the upper sepal of a Larkspur is *produced* above into a spur.

Proliferous: (literally, bearing offspring); where a new branch rises from an older one, or one head or cluster of flowers out of another, as in Filago Germanica, etc.

Prostrate: lying flat on the ground.

Proteine: a vegetable product containing nitrogen.

Protoplasm: the soft nitrogenous lining or contents of cells.

Pruinose, *Pruinate:* frosted; covered with a powder like hoar-frost.

Puberulent: covered with fine and short, almost imperceptible down.

Pubescent: hairy or downy, especially with fine and soft hairs or *pubescence.*

Pulverulent, or *Pulveraceous:* dusted; covered with fine powder, or what looks like such.

Pulvinate: cushioned, or shaped like a cushion.

Punctate: dotted, either with minute holes or what look as such (as the leaves of St. John's-wort and the Orange), or with minute projecting dots.

Pungent: very hard, and sharp-pointed; prickly-pointed.

Putamen: the stone of a drupe, or the shell of a nut.

Pyramidal: shaped like a pyramid.

Pyrene, *Pyrena:* a seed-like nutlet or stone of a small drupe.

Pyxis, *Pyxidium:* a pod opening round horizontally by a lid.

Quadri-, in words of Latin origin: four; as

Quadrangular: four-angled. *Quadrifoliate:* four-leaved.

Quadrifid: four-cleft.

Quaternate: in fours. *Quinate:* in fives.

Quincuncial: in a quincunx; when the parts in æstiviation are five, two of them outside, two inside, and one half out and half in, as shown in the calyx.

Quintuple: five-fold.

Race: a marked variety which may be perpetuated from seed.

Raceme: a flower-cluster, with one-flowered pedicels arranged along the sides of a general peduncle.

Racemose: bearing racemes, or raceme-like.

Rachis: see *rhachis.*

Radial: belonging to the ray.

Radiate, or *Radiant:* furnished with ray-flowers.

Radical: belonging to the root, or apparently coming from the root.

Radicant: rooting, taking root on or above the ground, like the stems of Trumpet-Creeper and Poison-Ivy.

Radicels: little roots or rootlets.

Radicle: the stem-part of the embryo, the lower end of which forms the root.

Rameal: belonging to a branch. *Ramose:* full of branches (*rami*).

Ramulose: full of branchlets (*ramuli*).

Raphe: see *rhaphe*.

Ray: the marginal flowers of a head or cluster, when different from the rest, especially when ligulate, and diverging (like rays or sunbeams); the branches of an umbel, which diverge from a centre.

Receptacle: the axis or support of a flower; the common axis or support of a head of flowers.

Reclined: turned or curved downwards; nearly recumbent.

Recurved: curved outwards or backwards.

Reduplicate (in æstivation): valvate with the margins turned outwards.

Reflexed: bent outwards or backwards.

Refracted: bent suddenly, so as to appear broken at the bend.

Regular: all the parts similar.

Reniform: kidney-shaped.

Repand: wavy-margined.

Repent: creeping, i. e., prostrate and rooting underneath.

Replum: the persistent frame of some pods (as of Prickly Poppy and Cress), after the valves fall away.

Reproduction, organs of: all that pertains to the flower and fruit.

Resupinate: inverted, or appearing as if upside down, or reversed.

Reticulated: the veins forming network.

Retroflexed: bent backwards; same as *reflexed*.

Retuse: blunted; the apex not only obtuse, but somewhat indented.

Revolute: rolled backwards, as the margins of many leaves.

Rhachis (the backbone): the axis of a spike, or other body.

Rhaphe: the continuation of the seed-stalk along the side of an anatropous ovule or seed.

Rhapides: crystals, especially needle-shaped ones, in the tissues of plants.

Rhizoma: a rootstalk.

Rhombic: in the shape of a rhomb. *Rhomboidal:* approaching that shape.

Rib: the principal piece, or one of the principal pieces, of the framework of a leaf; or any similar elevated line along a body.

Ring: an elastic band on the spore cases of Ferns.

Ringent: grinning; gaping open.

Rootlets: small roots, or root-branches.

Rootstock: root-like trunks or portions of stems on or under ground.

Rosaceous: arranged like the petals of a rose.

Rostellate: bearing a small beak (*rostellum*).

Rostrate: bearing a beak (*rostrum*) or a prolonged appendage.

Rosulate: in a regular cluster of spreading leaves, resembling a full or double rose, as the leaves of Houseleek, etc.

Rotate: wheel-shaped.

Rotund: rounded or roundish in outline.

Rudimentary: imperfectly developed, or in an early state of development.

Rugose: wrinkled, roughened with wrinkles.

Ruminated (albumen): penetrated with irregular channels or portions filled with softer matter, as a nutmeg.

Runcinate: coarsely saw-toothed or cut, the pointed teeth turned towards the base of the leaf, as the leaf of a Dandelion.

Runner: a slender and prostrate branch, rooting at the end, or at the joints, as of a Strawberry.

Sac: any closed membrane, or a deep purse-shaped cavity.

Sagittate: arrowhead-shaped.

Salver-shaped, or *Salver-form:* with a border spreading at right angles to a slender tube; as the corolla of Phlox.

Samara: a wing-fruit, or key, as of Maple, Ash and Elm.

Samaroid: like a samara or key-fruit.

Sap: the juices of plants generally.

Sarcocarp: the fleshy part of a stone-fruit.

Sarmentaceous: bearing long and flexible twigs (*sarments*), either spreading or procumbent.

Saw-toothed: see *serrate*.

Scabrous: rough or harsh to the touch.

Scalariform: with cross-bands, resembling the steps of a ladder.

Scaly: furnished with scales, or scale-like in texture.

Scandent: climbing.

Scape: a peduncle rising from the ground, or near it, as of the stemless Violets, the Bloodroot, etc.

Scapiform: scape-like.

Scarious, or *Scariose:* thin, dry, and membranous.

Scobiform: resembling sawdust.

Scorpioid, or *Scorpioidal:* curved or circinate at the end, like the tail of a scorpion, as the inflorescence of Heliotrope.

Scrobiculate: pitted; excavated into shallow pits.

Scurf, *Scurfiness:* minute scales on the surface of many leaves, as of Goosefoot, Buffalo-berry, etc.

Scutate: buckler-shaped.

Scutellate, or *Scutelliform:* saucer-shaped or platter-shaped.

Secund: one-sided; i. e., where flowers, leaves, etc., are all turned to one side.

Secundine: the innor coat of the ovule.

Segment: a subdivision or lobe of any cleft body.

Segregate: separated from each other.

Semi- (in compouud words of Latin origin): half; as

Semi-adherent, as the calyx or ovary of Purslane. *Semicordate:* half-heart-shaped. *Semilunar:* like a half-moon. *Semiovate:* half-ovate, etc.

Seminal: relating to the seed. *Seminiferous:* seed-bearing.
Sempevirent: evergreen.
Sepal: a leaf or division of the calyx.
Sepaloid: sepal-like. *Sepaline:* relating to the sepals.
Separated Flowers: those having stamens or pistils only.
Septate: divided by partitions (*septa*).
Septenate: with parts in sevens.
Septicidal: where a pod in dehiscence splits through the partitions, dividing each into two layers.
Septiferous: bearing the partition.
Septifragal: where the valves of a pod in dehiscence break away from the partitions.
Septum (plural *septa*): a partition, as of a pod, etc.
Serial, or *Seriate:* in rows; as *biserial*, in two rows, etc.
Sericeous: silky; clothed with satiny pubescence.
Serotinous: happening late in the season.
Serrate, or *Serrated:* the margin cut into teeth (*serratures*) pointing forwards.
Serrulate: same as the last, but with fine teeth.
Sessile: sitting; without any stalk, as a leaf destitute of petiole, or an anther destitute of filament.
Seta: a bristle, or a slender body or appendage resembling a bristle.
Setaceous: bristle-like. *Setiform:* bristle-shaped.
Setigerous: bearing bristles. *Setose:* beset with bristles or bristly hairs.
Sex: six; in composition. *Sexangular:* six-angled, etc.
Sheath: the base of such leaves as those of Grasses, which are
Sheathing: wrapped round the stem.
Shield-shaped: same as *scutate*, or as *peltate*.
Sigmoid: curved in two directions, like the letter S, or the Greek *sigma*.
Siliculose: bearing a silicle, or a fruit resembling it.
Silicle: a pouch, or short pod of the Cress Family.
Silique: a longer pod of the Cress Family.
Siliquose: bearing siliques or pods which resemble siliques.
Silky: glossy with a coat of fine and soft, close-pressed, straight hairs.
Silvery: shining with white or blueish-gray, usually from a silky pubescence.
Simple: of one piece; opposed to *compound*.
Sinistrorse: turned to the left.
Sinuate: strongly wavy; with the margin alternately bowed inwards and outwards.
Sinus: a recess or bay; the re-entering angle or space between two lobes or projections.
Soboliferous: bearing shoots from near the ground.
Solitary: single; not associated with others.

Sorus (plural *sori*): the proper name of a fruit-dot of Ferns.
Spadix: a fleshy spike of flowers.
Spathaceous: resembling or furnished with a
Spathe: a bract which inwraps an inflorescence.
Spatulate or *Spathulate:* shaped like a spatula.
Spicate: belonging to or disposed in a spike.
Spiciform: a shape resembling a spike.
Spike: an inflorescence like a raceme, only the flowers are sessile.
Spikelet: a small or secondary spike; the inflorescence of Grasses.
Spine: a thorn.
Spindle-shaped: tapering to each end like a radish.
Spinescent: tipped by or degenerating into a thorn.
Spinose or *Spiniferous:* thorny.
Sporangia or *Sporocarps:* spore-cases of Ferns, Mosses, etc.
Spore: a body resulting from the fructification of Cryptogamous plants, in them taking the place of a seed.
Sporule: same as a spore, or a small spore.
Spur: any projecting appendage of the flower, looking like a spur.
Squamate, *Squamose*, or *Squamaceous:* furnished with scales (*squamæ*).
Squamellate or *Squamulose:* furnished with little scales (*squamellæ* or *squamulæ*).
Squamiform: shaped like a scale.
Squarrose: where scales, leaves, or any appendages, or spreading widely from the axis on which they are thickly set.
Squarrulose: dimunitive of *squarrose:* slightly squarrose.
Stalk: the stem, petiole, peduncle, etc., as the case may be.
Staminate: furnished with stamens; *Stamineal:* relating to the stamens.
Staminodium: an abortive stamen, or other body resembling a sterile stamen.
Standard: the upper petal of a papilionaceous corolla.
Starch: a well-kown vegetable product.
Station: the particular place or kind of situatiou in which a plant naturally occurs.
Stellate, *Stellular:* starry or star-like; where several similar parts spread out from a common center, like a star.
Stemless: destitute, or apparently destitute of stem.
Sterile: barren or imperfect.
Stigma: the part of the pistil which receives the pollen.
Stigmatic or *Stigmatose:* belonging to the stigma.
Stipe (Latin *stipes*): the stalk of a pistil, etc., when it has any; the stem of a Mushroom.
Stipel: a stipule of a leaflet, as of the Bean, etc.
Stipellate: furnished with stipels, as the Bean and some other Leguminous plants.

Stipulate: furnished with stipules.

Stipitate: furnished with a stipe, as the pistil of Cleome.

Stipules: the appendages one each side of the base of certain leaves.

Stolons: trailing or reclined and rooting shoots.

Stoloniferous: producing stolons.

Stomate (Latin *stoma*, plural *stomata*) : the breathing pores of leaves. etc.

Strap-shaped: long, flat and narrow.

Striate or *Striated:* marked with slender, longitudinal grooves or channels (Latin *striæ.*)

Strict: close and narrow ; straight and narrow.

Strigillose, *Strigose:* beset with stout and appressed, scale-like or rigid bristles.

Strobilaceous: relating to or resembling a

Strobile: a multiple fruit in the form of a cone or head, as that of the Hop and of the Pine.

Strophiole: same as *caruncle*. *Strophiolate:* furnished with a strophiole.

Struma: a wen ; a swelling or protuberance of any organ.

Style: a part of the pistil which bears the stigma.

Stylopodium: an epigynous disk, or an enlargement at the base of the style, found in Umbelliferous and some other plants.

Sub-, as a prefix : about, nearly, somewhat ; as *sub-cordate*, slightly cordate ; *sub-serrate*, slightly serrate ; *sub-axillary* ; just beneath the axil, etc., etc.

Suberose: corky or cork-like in texture.

Subulate: awl-shaped ; tapering from a broadish or thickish base to a sharp point.

Succulent: juicy or pulpy.

Suckers: shoots from subterranean branches.

Suffrutescent: slightly shrubby or woody at the base only.

Sulcate: grooved longitudinally in long furrows.

Supervolute: plaited and convulute in bud.

Supra-axillary: borne above the axil, as some buds.

Supra-decompound: many times compounded or divided.

Surculose: producing suckers, or shoots resembling them.

Suspended: hanging down. Suspended ovules or seeds hang from the very summit of the cell which contains them.

Sutural: belonging or relating to a suture.

Suture: the line of junction of contiguous parts grown together.

Sword-shaped: vertical leaves with acute parallel edges, tapering above to a point.

Symmetrical Flower: similar in the number of parts of each set.

Synantherous or *Syngenesious:* where stamens are united by their anthers.

Syncarpous (fruit or pistil): composed of several carpels consolidated into one.

Systematic Botany: the study of plants after their kinds.

Taper-pointed: same as *acuminate.*
Tap-root: a root with a stout tapering body.
Tawny: dull yellowish, with a tinge of brown.
Taxonomy: the part of Botany which treats of classification.
Tegmen; a name for the inner seed-coat.
Tendril: a thread-shaped body used for climbing: it is either a branch as in Virginia Creeper; or a part of a leaf, as in Pea or Vetch.
Terete: long and round; same as *cylindrical*, only it may taper.
Terminal: borne at, or belonging to, the extremity or summit.
Terminology: the part of the science which treats of technical terms; same as *glossology.*
Ternate: in threes; *Ternately:* in a ternate way.
Testa: the outer (and usually the harder) coat or shell of the seed.
Tetra- (in words of Greek composition): four, as
Tetracoccous: of four cocci or carpels.
Tetradynamous: where a flower has six stamens, two of them shorter than the other four, as in Mustard.
Tetragonal: four-angled. *Tetragynous:* with four pistils or styles.
Tetramerous: with its parts or sets in fours.
Tetrandrous: with four stamens.
Theca: a case; the cells or lobes of the anther.
Thread-shaped: slender and round, or roundish like a thread; as the filament of stamens generally.
Throat: the opening or gorge of a monopetalous corolla, etc., where the border and the tube join, and a little below.
Thyrse or *Thyrsus:* a compact and pyramidal panicle.
Tomentose: clothed with matted wooly hairs (*tomentum.*)
Tongue-shaped: long, flat, but thickish and blunt.
Toothed: furnished with teeth or short projections of any sort on the margin, used especially when these are sharp, like saw-teeth, and do not point forwards.
Top-shaped: shaped like a top, or a cone with its apex downwards.
Torose, Torulose: knobby; where a cylindrical body is swollen at intervals.
Torus: the receptacle of the flower.
Tri-, in composition: three; as
Triadelphous: stamens united by their filaments into three bundles.
Triandrous: where the flower has three stamens.
Trichotomous: three-forked. *Tricoccous:* of three cocci or roundish carpels.
Tricolor: having three colors. *Tricostate:* having three ribs.
Tricuspidate: three-pointed. *Tridentate:* three-toothed.
Triennial: lasting for three years.
Trifarious: in three vertical rows; looking three ways.
Trifid: three-cleft.

16

Trifoliate: three-leaved. *Trifoliolate:* of three leaflets.
Trifurcate: three-forked. *Trigonous:* three-angled or triangular.
Trigynous: with three pistils or styles. *Trijugate:* in three pairs (*jugi.*)
Trilobed, or *Trilobate:* three-lobed.
Trilocular: three-celled.
Trimerous: with its parts in threes, as Trillium.
Trinervate: three-nerved, or with three slender ribs.
Triœcious: where there are three sorts of flowers on the same or different individuals; as in Red Maple.
Tripartible: separable into three pieces. *Tripartite:* three-parted.
Tripetalous: having three petals.
Triphyllous: three-leaved; composed of three pieces.
Trippinate: thrice pinnate. *Tripinnatifid:* thrice pinnately cleft.
Triple-ribbed, *Triple-nerved*, etc.: where a midrib branches into three near the base of the leaf, as in Sunflower.
Triquetrous: sharply three-angled; and especially with the sides concave, like a bayonet.
Triserial, or *Triseriate:* in three rows, under each other.
Tristichous: in three londitudinal or perpendicular ranks.
Tristigmatic, or *Tristigmatose:* having three stigmas.
Trisulcate: three-grooved.
Triternate: three times ternate.
Trivial Name: the specific name.
Trochlear: pulley-shaped.
Trumpet-shaped: tubular, enlarged at or towards the summit, as the corolla or Trumpet-Creeper.
Truncate: as if cut off at the top.
Trunk: the main stem or general body of a stem or tree.
Tuber: a thickened portion of a subterranean stem or branch, provided with eyes (buds) on the sides; as a potato.
Tubercle: a small excrescence.
Tubercled, or *Tuberculate:* bearing excrescences or pimples.
Tuberous: resembling a tuber. *Tuberiferous:* bearing tubers.
Tubular: hollow and of elongated form; hollowed like a pipe.
Tumid: swollen: somewhat inflated.
Tunicate: coated; invested with layers, as an onion.
Turbinate: top-shaped. *Turgid:* thick as if swollen.
Turio (plural *turiones*): young shoots or suckers springing out of the ground; as Asparagus-shoots.
Turnip-shaped: broader than high, abruptly narrowed below.
Twin: in pairs (see *germinate*), as the flowers of Linnæa.
Twining: ascending by coiling round a support, like the Hop.
Typical: well expressing the characteristics of a species, genus, etc.

Umbel: the umbrella-like form of inflorescence.
Umbellate: in umbels. *Umbelliferous:* bearing umbels.
Umbellet: a secondary or partial umbel.
Umbilicate: depressed in the centre, like the ends of an apple.
Umbonate: bossed; furnished with a low, rounded projection like a boss (*umbo*).
Umbraculiform: umbrella-shaped, like a Mushroom, or the top of the style of Sarracenia.
Unarmed: destitute of spines, prickles and the like.
Uncinate: hook-shaped; hooked over at the end.
Under-shrub: partially shrubby, or a very low shrub.
Undulate: wavy, or wavy-margined.
Unequally pinnate: pinnate with an odd number of leaflets.
Unguiculate: furnished with a claw (*unguis*); i: e. a narrow base, as the petals of a Rose, where the claw is very short, and those of Pinks where the claw is very long.
Uni-, in compound words: one; as
Uniflorous: one-flowered. *Unifoliate:* one-leaved.
Unifoliolate: of one leaflet; *Unijugate:* of one pair.
Unilabiate: one-lipped. *Unilateral:* one-sided.
Unilocular: one-celled.
Uniovulate: having only one ovule.
Uniserial: in one horizontal row.
Unisexual: having stamens or pistils only, as in Moonseed.
Univalved: a pod of only one piece after dehiscence.
Urceolate: urn-shaped.
Utricle: a small, thin-walled, one-seeded fruit, as of Goosefoot.
Utricular: like a small bladder.

Vaginate: sheathed, surrounded by a sheath (*vagina.*)
Valve: one of the pieces (or doors) into which a dehiscent pod, or any similar body, splits.
Valvate, *Valvular:* opening by valves. *Valvate* in æstivation.
Vascular: containing vessels, or consisting of vessels, such as ducts.
Vaulted: arched; same as *fornicate.*
Veil: the calyptra of Mosses.
Veins: the small ribs or branches of the framework of leaves, etc.
Veined, Veiny: furnished with evident veins. *Veinless:* destitute of veins.
Veinlets: the smaller ramifications of veins.
Velate: furnished with a veil.
Velutinous: velvety to the touch.
Venation: the veining of leaves, etc.
Venose: veiny; furnished with conspicuous veins.
Ventral: belonging to that side of a simple pistil, or other organ, which looks towards the axis or centre of the flower; the opposite of dorsal.

Ventricose: inflated or swelled out on one side.
Venulose: furnished with veinlets.
Vermicular: shaped like worms.
Vernation: the arrangement of the leaves in the bud.
Vernicose: the surface appearing as if varnished.
Verrucose: warty; beset with little projections like warts.
Versatile: attached by one point, so that it may swing to and fro, as the anthers of the Lily and Evening Primrose.
Vertex: same as the *apex*.
Vertical: upright; perpendicular to the horizon, lengthwise.
Verticil: a whorl. *Verticillate:* whorled.
Vesicle: a little bladder. *Vesicular:* bladdery.
Vexillary, *Vexillar:* relating to the
Vexillum: the standard of a papilionaceous flower.
Villose: shaggy with long and soft hairs (*villosity*).
Vimineous: producing slender twigs, such as those used for wicker-work.
Vine: any trailing or climbing stem; as a Grape-vine.
Virescent, *Viridescent:* greenish; turning green.
Virgate: wand-shaped, as a long, straight, and slender twig.
Viscous, *Viscid:* having a glutinous surface.
Vitta (plural *vittæ*): the oil-tubes of the fruit of Umbelliferæ.
Voluble: twining, as the stem of Hops and Beans.

Wavy: the surface or margin alternately convex and concave.
Waxy: resembling beeswax in texture or appearance.
Wedge-shaped: broad above, and tapering by straight lines to a narrow base.
Wheel-shaped: see *rotate*.
Whorl, *Whorled:* when leaves, etc., are arranged in a circle round the stem.
Wing: any membranous expansion.
Winged: furnished with a wing; as the fruit of Ash and Elm.
Wood, *Woody:* of the texture or consisting of wood.
Woolly: clothed with long and entangled soft hairs: as the leaves of Mullein.

SYNONYMS AND VARIETIES.

A

E. acmenoides—*Syn.:* trianthos. At one time ranked as a variety of pilularis.

E. amygdalina—*Syns.:* radiata, elata, tenueramis, nitida, longifolia. Lindleyana, ambigua, ligustrina, fissilis. *Vars.:* linearis, dives, angustifolia, hypericifolia, regnans. Both Risdoni and coccifera have been called forms of amygdalina.

E. alba—Bark white, persistent. *Syn.:* leucadendron. *Var.:* tectifica. Close to platyphylla, Timor.

B

E. Baileyana—Fibrous on both stem and branches; bark stringy; poor soil and sandy ridges; similar to Eucalyptus Bowmanii. Was called *Var.* of Eucalyptus drepanophylla; also like trachyphloia and eugenioides, in this case fruits very different, resembling those of dichromophloia.

E. botryoides—Bark persistent dark, wrinkled, one case here decorticates. *Syn.:* platypodas.

E. Behriana—*Var:* purpurascens.

E. bicolor—*Syns.:* pendula, largiflorens, haemastoma. *Var.:* passiflora.

C

E. corynocalyx—*Syn.:* cladocalyx; stony and dry districts. Seedlings round leaf.

E. capitellata—Bark stringy. Has been called Eucalyptus piperita; closely allied to santalifolia. *Var.:* brachycorys ; this variety also attributed to macrorrhyncha.

E calophylla—*Syn.:* splachnocarpa, allied to ficifolia.

E. clavigera—*Syn.:* polysciadia.

E. cornuta—*Syns.:* macrocera, symphomyrtus, annulata. Lehmanni has also been called a form of this tree.

E. corymbosa—*Syns.:* metrosideros, gummifera.

E. coccifera—*Var.:* parviflora.

E. crebra—The following may eventually be ranked as forms of crebra: Melanophloia, drephanophylla, trachyphloia and leptophleba and perhaps also the lemon scented iron bark E. Staigeriana (have seen no description of this last.—K.) *Syns.:* resinifera and metrosideros, salicifolium and perhaps angustifolia and melanophloia.

E. conoidea—*Var.:* marginata.

D

E. **diversicolor**—*Syns.:* colossea, goniantha.

E. **dumosa**—*Syns.:* lamprocarpa, santalifolia, fruticetorum. *Var.:* conglobata, scyphocalyx, panticulata, rhadophloia.

E

E. **eugenioides**—*Syns.:* scabra, acervula, piperita.

F

E. **foecunda**—*Var.:* loxophleba, foecunda, small shrubby form—loxophleba—tree form. *Syns.:* amygdalina, fruticetorum.

G

E. **goniocalyx**—Bark rough in dry country. Smooth in mountain gorges. *Syn.:* elæophora.

E. **gracilis**—Shrubby; bark smooth. *Syns.:* calycogna, celastroides, fruticetorum.

E. **globulus**—*Syns.:* cordata, diversifolia, glauca, pulverulenta, perfoliata. *Var.:* shrubby form unnamed.

E. **Gunnii**—Bark rough, dark; always decorticating. *Vars.:* doubtful; ligustriana, Baueriana and persicifolia. *Syns.:* ligustriana, acervula.

H

E. **hemiphloia**—*Syn:* albens. *Var.:* brevifolia for oil.

E. **haemostoma**—Bark smooth, or if persistent on stem smooth on branches. *Var.:* micranthera, smaller fruit and flower. *Syns.:* signata, fair fuel, poor timber.

I

E. **incrassata**—*Syns.:* angulosa, cuspidata, costata. Muelleri.

L

E. **largiflorens**—*Syns.:* neudula, bicolor and haemastoma.

E. **leucoxylon**
E. **sideroxylon** } *Vars.:* angulata, pallens, minor; wide range; seedlings of Eucalyptus leucoxylon; willowy, vine-like growth; leaves opposite, sessile; of sideroxylon, very fine leaf, narrow; stem crimson. Maiden and others think that the tree growing in New South Wales is different from Eucalyptus leucoxylon of South Australia and should have specific rank as Eucalyptus sideroxylon. The timber of the latter is reddish; of the former, white; both very strong; sideroxylon most durable.

E. **longifolia**—*Syn.:* Woolsei, fuel and bees. Seedling leaves narrow, paler beneath, generally scattered, smooth.

E. **loxophleba**—*Syn.:* fruticetorum. *Var.:* fruticosa.

M

E. **macrorrhyncha**—Stringy bark; foliage sometimes like obliqua; smaller tree than obliqua; seedlings rough glandular protuberances with hairy tufts. *Syn.:* acervula (ring). *Var.:* brachycorys.

E. marginata—*Syns.:* floribunda, hypoleuca, mahogani.

E. melliodora—Bark on stem rough persistent yellow and soft inside. Branches generally smooth; near leucoxylon and sideroxylon; needs good soil; seedling leaves oval, scattered; stalked. *Syn.:* patentiflora.

E. maculata—Bark smooth. *Var.:* citriodora; large tree; stem of citriodora not yet here marked or mottled as noted of maculata. *Syns.:* melissiodora, variegata, peltata.

E. microtheca—*Syns.:* brevifolia and brachypoda.

O

E. occidentalis—*Syns.:* macrandra, spathulata.

E. odorata—Bark grey, rough, persistent. *Syns.:* cajuputea, porosa. *Var.:* floribunda. Timber fair, resists decay, generally small.

E. obliqua—Bark fibrous and persistent on both stem and branches. *Syns.:* gigantea, fabrorum, nervosa, falcifolia, heterophylla. *Vars.:* obtusiflora, cneorifolia (dwarfed alpine form), dives opposite leaved form; large tree; timber does not last underground. One of the most gregarious of the Eucalypti.

P

E. pauciflora—Bark smooth. *Syns.:* coriacea, piperita, phlebophylla submultiplinervis and sylvicultrii. *Vars.:* procera, alpina; leaves sometimes very large and round in young plant; wood comparatively soft; stands cold.

E. pilularis—Bark persistent blackish grey; seedling leaves opposite sessile, very oblong; plant stiff and smooth. *Syns.:* persicifolia, semicorticata, ornata, incrassata, very close to acmenoides; timber good.

E. punctata—*Syns.:* Stuartiana, tereticornis . *Vars.:* longifolia. brachycorys.

E. pyriformis—*Syns.:* pruinosa erythrocalyx.

E. piperita—Bark rough, fibrous, persistent to branches. *Syn.:* acervula. *Var.:* laxiflora.

E. polyanthema—Bark persistent, grey, slightly furrowed. *Syn.:* polyanthemos. *Var.:* Baueriana and perhaps oligantha.

E. populifolia—Persistent, somewhat wrinkled bark. *Syns.:* populnea, largiflorens, platyphylla. *Var.:* parviflora.

E. Planchoniana—resembles Eucalyptus rigida. *Var.:* Leuhmanniana.

E. platypus—*Var.:* nutans.

E. paniculate—*Syn.:* terminalis. *Vars.:* fasciculosa, angustifolia conferta.

R

E. resinifera—*Var.:* spectabilis, broader, roundish leaves, nearly equal color on both sides and thicker. *Var.:* pellita—similar, but with longer leaves and partly paniculated flowers. These two are ranked as tropical forms. Also, *var.* hemilampra.

E. Kirtoniana is between resinifera and robusta. In the venation of leaves and order of these it is nearest robusta, while in shape of calyx-cap it is nearest resinifera. Also, *var.* grandiflora. Wide range.

E. robusta—*Syn.:* rostrata.

E. rostrata—Bark grey, generally persistent. *Syns.:* acuminata, longirostris, exserta and brachypoda. Forms of tereticornis and rudis approach rostrata closely. Seedling, leaves narrow, lanceolar.

E. rudis—*Syn.:* brachypoda.

E. redunca—*Syn.:* xanthonema. *Vars.:* angustofolio, melanophloia, elata.

S

E. spathulata—*Var.:* grandiflora.

E. saligna—Bark smooth—often shiny,—otherwise closely resembling E. botryoides. Along streams. *Var.:* hemilampra; between saligna and resinifera, with smooth bark; tall tree—fine timber.

E. Sieberiana—*Syn.:* virgata. Bark deep furrowed, dark brown; branches smooth and pale; tall tree—good timber.

E siderophloia—Bark rough, persistent, deeply furrowed. *Syn.:* persicifolia, resinifera. *Vars.:* fibrosa, rostrata.

E. Stuartiana—Bark fibrous, persistent. Owing to confusion of descriptions this name has been applied to both Gunnii and Viminalis. *Syns.:* persicifolia, Baueriana, falcifolia.

E. stricta—*Syns.:* virgata cnerifolia, microphylla. Cunninghami. *Vars.:* rigida and Leuhmannii—last very luxuriant in foliage.

E. stelulata—*Syns.:* microphylla, Cunninghami, stricta. *Var.:* angustifolia.

E. santalifolia—*Vars.:* firma. Baxteri.

T

E. tereticornis *Syns.:* subulata, or subulatum. *Vars.:* latifolia, brachycorys, brevifolia. Also, *Syns.:* leptospernum, umbellatum.

E. tetraptera—purple flower, pendant, shrubby. *Syn.:* acutangula.

E. tessilaris—*Var.:* Dallachiana. *Syns.:* Viminalis, Hookeri.

E. terminalis—*Syn.:* polycarpa.

V

E. viminalis—*Syns.:* mannifera, patentiflora, fabrorum, Gunnii, dealbata, santalifolia, granularis, persicifolia. Also confused with pilularis, diversifolia and elata. *Var.:* dealbata.

The confusion of names is to a great extent due to descriptions of species independently made by different botanists. Thus the same species has been described and named by different botanists without knowledge of each others work. The trouble is also due to great variability in the species, which often merge into each other or have striking differences of form.

TIMBER.

The genus of myrtles called Eucalyptus has for a long time furnished Australasia with timber for all useful purposes both on land and sea. Houses, ships, wagons, piles, railroad ties, bridges, fences, paving blocks, etc., have been and are made from timber of species of this genus. While all the species are hardwoods they differ greatly in durability, strength and facility of working, so also in various uses some are good for fuel, others will scarcely burn, some split with remarkable ease and others will not split at all. Great differences exist even in the same species in points of value. These differences are largely due to the soil or climate in which the wood grew. The extraordinary variations in the tables of strength of Eucalyptus timber, as between Warren, Maiden and Lastlett, for instance, and in the various reports on durability in water or under ground may be in part attributed to the locality from which the timber was taken, the season of cutting, the method of curing or the age of the tree. We may also assume that a careful and reliable checking of the species has not always been attended to by those furnishing the timber for testing.

Extended examinations of the Australian timbers have been made by Prof. J. H. Maiden, J. G. Leuhmann, Jas. Mitchell, Thos. Laslett, Baron Von Mueller, W. H. Warren and others. The following notes are taken from these works.

The principal drawbacks to this timber are its tendency to check or open fissures and shakes and its hardness and

consequent difficulty in working. Its general advantages are hardness, durability and strength. Besides these good qualities I have seen polished wood specimens from species of this genus at the different World Expositions that were strikingly beautiful. I have presented notes only on the species that seems to me most important. The concentric wood layers are often indistinct and are in my examinations no indication of age.

E. acmenoides — White mahogany. A tough, strong, useful timber. One of the most durable. Uses—posts, piles, girders, etc., and general building. Color, pale. Height, 40 to 60 feet. Sp. gravity, 1.066 (67¼ lbs. per cubic foot). The specific gravity in each of the species varies considerably. What I have given is generally the average of all the examinations accessible to me.

E. amygdalina—Peppermint-messmate. In this species the first difficulty we encounter is the lack of differentiation of the numerous striking varieties. Timber does not twist in drying, splits easily especially when taken from trees in glens or on bottom lands. *Uses*—shingles, pailings, rails; also for keelsons and planking in ships. Not a superior fuel. Comparatively light, floats in water. Specimen cut 25 years weighed 48 lbs. 10 oz. per cubic foot. Color, pale yellow. Height from 100 to 350 feet.

E. botryoides—Swamp mahogany or blue gum. Valuable timber, hard, tough, durable. When grown on rich soil considered one of the best timber trees of the species (Maiden). When grown on coast sands it is useful for sawing and fencing, though then the stems are often gnarled (Kirton). *Used* for knees of boats, posts, wagons, especially felloes. Generally very durable under ground. Does not split easily. Height, 50 to 100 feet.

TIMBER EXPERIMENTED UPON BY THE VICTORIAN TIMBER BOARD, 1884.

The samples tested were each 7' 0'' in length by 1⅞'' square; the distance between the bearings was 6' 0''; and the weight was gradually applied in the centre until the timber broke.

Local Name.	Botanical Name.	Locality Where Grown.	Approximate Date when the Timber was cut.	Date of Testing.	Weight of each Sample in lbs	Average Weight of Samples in lbs.	Average Weight per Cubic Foot in lbs.	Average Specific Gravity.	Breaking Weight of each Sample in cwts qrs. lbs.	Average Breaking Weight of Samples in lbs.	Deflection at Point of Rupture in Inches.	Average Deflection in Inches.	Total Average Deflection in Inches.	Average Specific Strength.	Geological Formation Where the Tree grew.	Elevation above Sea-level.
Gippsland mahogany.	*E. botryoides.*	North-eastern Gippsland	Do.	4-3-84	10	9.50	55.59	0.891	9.0.16	931.5	5¼	4.25	4.25	2543	Miocene.	Low-lying Ground
				4-3-84	9				7.1.20		4					
				4-3-84	9½				9.0.8		4½					
				4-3-84	9½				7.2.14		3¼					

E. capitellata—Stringy bark; good splitting timber. *Uses:* posts, rails, shakes, etc. Sp. gravity .838 (52.26 lbs. per cubic foot. Balfour). Height up to 200 feet.

E. calophylla—Redgum of W. A. Wood tough. *Used* for naves, spokes, ploughs, shafts, handles; also for frames, rails and various building purposes — not durable under ground (Mueller). Height up to 150 feet.

E. cornuta—Yate or Yeit. Hard and elastic wood, suggesting ash. Used for agricultural implements, boat ribs, etc. Heavy, sinks in water. Sp. gravity when well dried, 1.235. Height up to 100 feet.

E. corymbosa—Bloodwood. Subject to gum veins, and consequently not so good for sawn timber. Very durable; resists white ants, damp, etc. Does not burn readily. Easily worked when fresh, but soon becomes very hard; generally dark red color (Maiden). Height 80 to 100 feet.

E. corynocalyx — Sugar gum. Timber very heavy; of great lateral strength, very hard when dry, and durable. Resists insects, ants, damp rot, etc. One of the least likely to warp of the genus. *Uses:* railroad ties, joists, rafters, piles, planking, naves and felloes of wheels, etc. (J. E. Brown). Weighs 69 lbs. per cubic foot (Warren). Color, pale yellow. Height up to 120 feet.

E. crebra—Narrow-leaved; iron bark. Hard, tough, of inlocked fibre. *Uses:* fence-posts, building, sleepers, bridges, piles, wheelwright work, etc. (Maiden). Very heavy. Sp. gravity 1.211 (Capt. Ward). Color, rich brown. Height 60 to 100 feet.

E. diversicolor—Karri. Wood straight in grain, tough, bends easily but is not as easily worked as Eucalyptus marginata. *Uses:* large planks, scantlings, piles, wheelwright work, rudders, masts, etc. Does not finish well; very dur-

able in water; subject to star-shake. Color sometimes red, sometimes pale indefinite. Height up to 300 feet or even more.

TABLE SHOWING COMPARATIVE TESTS OF "INDIAN TEAK" AND "ENGLISH OAK:"

Compared with Western Australian Tuart (*E. gomphocephala*), Jarrah (*E. Marginata*), and Karri (*E. diversicolor*).

Name of Wood.	Weight per cubic foot.	Specific gravity.	Transv'se strength per square inch.	Average Tensile Experiments			Vertical or crushing strains on cubes of 2 in.	Number of years assigned by English Lloyds for ship building purposes.
				Dimensions of each piece.	Weight the piece broke with.	Direct cohesion of 1 sq. in.		
	Lbs.		Value of S.	Inches.	Lbs. per sq. in.	Lbs. per sq. in.	In tons per sq. in	
Indian Teak	49.47	807	2203	2 x 2 x 30	13,207	3,301	2838	14 years.
English Oak	31.72	886	2117	2 x 2 x 30	30,287	7,571	3411	9 "
Tuart	73.06	1169	2701	2 x 2 x 30	40,487	10,284	4195	—
Jarrah	63.12	1010	1800	2 x 2 x 30	11,760	2,940	3198	12 "
Karri	61.31	981	2264	2 x 2 x 30	28,280	7,070	5140	12 "

From the Official Catalogue of Western Australia, Melbourne International Exhibition, 1880.

E. eugeneoides—Stringy bark. Timber split well but not so well as other stringy bark, but not more lasting than these. *Uses;* flooring boards, palings, rails, etc.; inferior fuel. Color, pale. Height up to 150 feet.

E. eximia—Rusty gum; poor timber; good fuel.

E. globulus—Blue gum or fever tree. Tall, straight growing; wood moderately strong, hard, heavy, grain twisted or curled. In seasoning deep shakes occur from the surface and it shrinks and warps considerably (Laslett.)

In water it swells greatly, thus in the Tasmanian vessels built of this timber the seams are scarcely discernable when these are taken on the ways for coppering. Uses: Ship-building, wheelwright work, agricultural implements, telegraph poles, piles, bridges. Its use for railroad sleepers has been of late years supplanted by Eucalyptus rostrata (checks too much for their use with ordinary seasoning, K). Laslett says that the old trees often decay about the heart-wood like some of our old oaks. It is deemed to be useful in the ways spoken of after the eighth or tenth year of age. Heart wood and sap wood are generally rejected in Tasmania as not durable. Color, generally pale yellow, sometimes brown or grey. Height up to 330 feet. Sp. gravity average by Balfour, 1.014 (63.19 lbs per cubic foot).

TRANSVERSE EXPERIMENTS.

(*Laslett.*)

Pieces 7 feet long by 2 inches square. Weight suspended in the middle; both ends free.

No. of the Specimen.	Deflections.			Total weight required to break each piece.	Specific gravity.	Weight reduced to specific gravity 1000.	Weight required to break one square inch.
	With the Apparatus weighing 390 lb	After the Weight was removed.	At the crisis of breaking.				
	Inches.	Inches.	Inches.	Lbs.			Lbs.
1	1.25	.15	4 50	767	1079	711	191.75
2	1 75	.20	3.75	602	997	604	150.50
3	1.35	.10	5 75	710	1037	684	177.50
4	1 00	.00	3 75	767	1108	692	191.75
5	1.25	.15	3.50	684	1026	666	171.00
6	1 00	.00	4 00	741	924	801	185.25
Average	1.26	.10	4.21	712	1029	693	177.96

Each piece broke with a short fracture.

TENSILE EXPERIMENTS.
(*Laslett.*)

Number of the specimen.	Dimensions of each piece.	Specific gravity.	Weight the piece broke with.	Direct cohesion on 1 square inch.
	Inches.		Lbs.	Lbs.
7	2 x 3 x 30	997	14560	3640
8		1079	26600	6650
9		1037	24360	6090
10		1108	26600	6650
11		1026	28840	7210
Average.		1049	24192	6048

VERTICAL OR CRUSHING STRAIN ON CUBES OF TWO INCHES.

No. 12. Tons.	No. 13. Tons.	No. 14. Tons.	No. 15. Tons.	No. 16. Tons.	No. 17. Tons.	Total. Tons.	Average. Tons.	Ditto on 1 square inch. Tons.
12875	13000	12750	11125	10500	13625	73875	12312	3078

E = 778300. S = 1869.

EXPERIMENTS ON THE TRANSVERSE STRENGTH OF WOOD of *E. globulus*, by Baron von Mueller and J. G. Luehmann. The pieces were two inches square, two feet long between the supports, the weight suspended in the middle, both ends free. The timber was seasoned nine months.

No.	Deflection.			Total weight required Break each piece.	$S = \frac{LW}{4bd2}$	Specific Gravity.
	With Apparatus Weighing 720 lbs.	After the Weight was Removed.	At the Crisis of Breaking.			
	Inches.	Inches.	Inches.	Lbs.		
1	.12	.04	.75	2444	1833	.938
2	.08	Nil.	.62	3224	2418	.992
3	.16	.04	.58	2256	1692	.913
4	.12	.04	.75	2661	1996	.942
5	.10	.02	.75	2740	2055	.946
6	.12	.03	.55	2288	1716	.927
7	.12	.02	.75	2409	1807	.924
8	.12	.04	.58	2280	1710	.845
9	.16	.04	.62	2252	1689	.852
10	.05	Nil.	.58	3752	2814	1.094
11	.08	Nil.	.65	3024	2268	1.096

$$S \text{ (strength)} = \frac{L \text{ (length)} \times W \text{ (weight)}}{4 \times b \text{ (breadth)} \times d2 \text{ (depth 2)}}$$

"BLUE GUM" (*E. globulus*) EXPERIMENTED UPON BY THE VICTORIAN TIMBER BOARD (1884)

The samples tested were each 7 feet in length by 1⅞ inches square; the distance between the bearings was 6 feet; and the weight was gradually applied in the centre until the sample broke.

Locality Where Grown	Appproximate Date when the Timber was Cut	Dimensions of Tree	Date of Testing	Weight of each Sample in lbs	Average Weight of Samples in lbs	Average weight per Cubic Foot in lbs	Average Specific Gravity	Total Average Specific Gravity	Breaking weight of each Sample in cwts, qrs, lbs	Average Breaking Weight of Samples in lbs	Total Average Breaking Weight	Deflection at Point of Rupture in Inches	Average Deflection in Inches	Total Average Deflection in Inches	Average Specific Strength	Geological Formation Where the Trees Grew	Elevation above Sea Level
Mirboo.		4 ft	7-2-84	11					9.1.25			3½					
Victoria	23-12-82	4¾ in	28-1-84	10½	10.75		1,008		9.3.13	1111.6		4¼	4.16			Mesozoic	700 to 800 ft
		diam	31-1-84	10¾					10.1.21			4¾					
Range south		3 ft	31-1-84	11					9.3.24			4½					
of Waterloo.	---4-83	6 in	31-1-84	11¾	11.42	65.18	1.071	1.045	8.3.6	1023.6	1112.1	3½	3.83	3.99	3.036	Mesozoic	About 1250 ft
Victoria.		diam	4-2-84	11½					8.2.17			3½					
Corner Inlet, S. E. Victoria.	—	—	24-1-84	11¼	11.25		1.055		10.2.25	1201.0	—	—	—			Granite	—
			24-1-84	10¾					8.1.20			4⅜					
Southern New	Seasoned at least twelve months	—	31-1-84	11	10.58	61.91	0.992	0.992	6.3.9	821.6	851.6	3¾	4.12	4.12	2.325	—	—
South Wales			4-2-84	10					7.2.6			4¼					

E. gomphocephela, Touart, Tooart or Tewart (also called white gum)—Wood heavy, durable, tough; grain close, curled or twisted, does not easily rend; shrinks little in seasoning. Said to be the least subject of any Eucalyptus to heart or star shakes. One of the strongest timbers in the world. Laslett says that he has seen a specimen of this wood subjected to a ten year test of weather exposure with only in the least degree showing any effect. Stands high temperatures as in an engine room Uses: shipbuilding stern posts, keelsons and work below the line of flotation, also for bridges, scantlings, etc. Color, pale yellow or brown. Height up to 150 feet.

TRANSVERSE EXPERIMENTS. *(Laslett.)*

Number of Specimen	Deflections: With the Apparatus Weighing 390 lbs.	Deflections: After the Weight was removed	Deflections: At the crisis of Breaking	Total Weight required to Break each Piece	Specific Gravity	Weight reduced to Specific Gravity 1000	Weight required to Break 1 square inch
	Inches	Inches	Inches	Lbs.			Lbs.
1	1.25	.15	4.50	1071	1147	942	267.75
2	1.25	.00	4.50	972	1173	829	243.00
3	1.15	.20	5.00	1032	1184	872	258.00
4	1.25	.15	5.00	1116	1147	973	279.00
5	1.35	.05	4.85	1017	1170	869	254.25
6	1.35	.10	4.65	966	1194	809	241.50
Average	1.27	.108	4.75	1029	1169.16	882.23	257.25

Each piece broke with moderate length of fracture, and very fibrous.

TENSILE EXPERIMENTS. *(Laslett.)*

Number of Specimen	Dimensions of each piece	Specific Gravity	Weight the piece broke with	Direct cohesion on 1 square inch
	Inches		Lbs.	Lbs.
7	2 x 2 x 30	1147	32580	8820
8	2 x 2 x 30	1184	44520	11130
9	2 x 2 x 30	1173	46900	11725
10	2 x 2 x 30	1170	34160	8540
11	2 x 2 x 30	1147	34720	8680
12	2 x 2 x 30	1194	51240	12810
Average		1169	40687	10284

"TEWART," "TOOART," "TUART" (EUCALYPTUS GOMPHOCEPHALA) EXPERIMENTED UPON BY THE VICTORIAN TIMBER BOARD, 1884.

Locality where Grown	Approximate Date when the Timber was cut	Date of Testing	Weight of each Sample in lbs.	Average Weight of Samples in lbs.	Average Weight per Cubic Foot in lbs.	Average Specific Gravity	Total Average Specific Gravity	Breaking Weight of each Sample in cwts. qrs. lbs.	Average Breaking Weight of Samples in lbs.	Total Average Breaking Weight	Deflection at Point of Rupture in Inches	Average Deflection in Inches	Total Average Deflection in Inches	Average Specific Strength
Western Australia	Seasoned at least twelve months	28-1-84	12	11.92	66.06	1117	1058	10,0.23	1119.0	1108.0	3⅝	3.79	4.02	3025
		4-2-84	12					10,0.2			4			
		4-2-84	11¾					9.3.0			3¾			
		31-1-84	10¾	10.66		1000		9.3.11	1097.0		4½	4.25		
		4-2-84	10¼					9.2.6			4			
		4-2-84	11					9.3.26			4¼			

N. B.—Under Eucalyptus diversicolor will be found a table of comparative experiments with that timber, Eucalyptus gomphocephala, Eucalyptus marginata, English Oak, and Indian Teak.

VERTICAL EXPERIMENTS.

(Laslett.)

Number of the Specimen	1 Inch	2 Inches	3 Inches	4 Inches
	Crushed with	Crushed with	Crushed with	Crushed with
	Tons	Tons	Tons	Tons
13–16	4.000	16.875	37.625	67.00
17–20	4.500	16.750	33.125	64.25
21–22	4.625	16.500		
23–24	4.750	17.000		
Average	44.69	16.781	35.375	65.625
Do. per inch	4.469	4.195	3.931	4.102
E = 776,990 S = 2,701				

E. goniocalyx — Spotted gum, grey gum, white gum, blue gum and grey box. Wood hard, tough, and usually free from kino veins; durable, specially in ground; difficult to split. *Uses:* wheelwright, boat building, railroad ties; also good fuel. Color, pale yellow or brownish.

E. hemiphloia — Yellow box, grey box, canarywood. Hard, tough, durable, very heavy and of great lateral strength. *Uses:* railroad sleepers, wheelwright work, piles, scantlings, planks, posts, mauls, large screws, cogs and ship building. Does not split easily. Color, yellow or very pale brown. Height 50 to 60 feet. Sp. gravity 1.230.

"CANARE WOOD" (*E. hemiphloia*) EXPERIMENTED UPON BY THE VICTORIAN TIMBER BOARD, 1884.

The samples tested were each 7ft. in length by 1⅞in. square; the distance between the bearings was 6ft.; and the weight was gradually applied in the centre until the sample broke.

Locality Where Grown.	Approximate Date when the Timber was cut.	Dimension of of Trees.	Date of Testing	Weight of each Sample in lbs	Average Weight of Samples in lbs	Average Weight per Cubic Foot in lbs	Average Specific Gravity	Breaking Weight of each Sample in cwts. qrs. lbs.	Average Breaking Weight of Samples in lbs.	Deflection at Point of Rupture in inches.	Average Deflection in Inches.	Average Specific Strength.
Queensl'nd	Seasoned at least twelve months	About 2ft. diameter	31-1-84 31-1184	8 8½	8.25	48.27	0.773	8.3.22 8.2.8	981.0	3¾ 4½	4.12	2678

E. leucoxylon — South Australian blue gum. Durable, tough and of great lateral strength. Good in soil or water. Railroad sleepers, bridge piles and planking, naves and felloes of wheels, wagon shafts, telegraph poles, beams, axe handles. 63½ to 71 lbs. per cubic foot. Wood slightly greasy, which makes it good for cogs in heavy mill wheels. Close and straight grained. Color, pale yellow or pink.

Deflection.		Total weight required to break each piece.	Value of strength, $S=\frac{L\,W}{4BD^2}$	Specific gravity.	
With the Apparatus weighing 780 lbs.	At the crisis of breaking.			Air dried.	Absolutely dried.
Inches	Inches	Pounds			
.03	.63	4192	3144	1.028	.908
.03	.60	3977	2983	1.061	.913

E. longifolia—Wooly butt. Very durable but deficient in strength and elasticity. Uses: Posts, sleepers, and especially recommended by Maiden for wood paving. Also used generally. Color, dark red, with wavy grain. Height 100 to 130 feet. Specific gravity, 1.187 (68½ lbs. to cubic foot of dried wood).

E. macrorrhyncha—Stringy bark. Hard, light, strong and close grained, and takes good polish. Chiefly used for fencing and wheelright work. Splits easily. Color, brown; sometimes pale. Height 50 to 100 feet. Specific gravity, 937. A post of this wood set in the ground in 1815 was dug up sound in 1861, (Sir William Macarthur).

E. maculata—Spotted gum. Strong, close grained, durable. Splits easily. It is the coarsest grain of the Eucalyptus. Uses: Shingles, staves, general building, street paving, shipbuilding, wheelwright work. Pretty, wavy grain. Color, dark yellow or brown. Height 100 to 150 feet. Specific gravity, 1,035.

E. maculata—Var. citriodora. Lemon scented gum. Similar wood to preceeding but lighter and more pliable. Specific gravity, .942. Height, 40 to 70 feet.

E. marginata—Jarrah. Very celebrated for its powers of resisting marine molusca. Also for durability in ground. As we cannot grow this timber for commercial use and its value for piling has been elsewhere spoken of, it seems unnecessary to go further into its uses. Color, red. Handsome; takes good polish.

TRANSVERSE EXPERIMENTS.

(*Laslett.*)

Number of the specimen.	Deflections. With the apparatus weigh'g 390 lbs.	Deflections. After the weight was removed	Deflections. At the crisis of breaking	Total Weight required to break each piece.	Specific gravity	Weight reduced to specific gravity, 1000	Weight required to break one square inch
	Inches	Inch	Inches	Lb.			Lb.
1	2.85	.10	4.50	743	987	753	185.75
2	3.25	.15	4.50	638	1049	608	159.50
3	3.25	.15	5.00	661	977	677	165.25
4	3.50	.15	5.00	661	1039	636	165.25
5	3.15	.10	4.50	726	1006	722	181.50
6	3.25	.15	4.75	685	1002	684	171.25
Total	19.25	.80	28.25	4114	6060	4080	1028 50
Average	3.21	.133	4.71	685 66	1010	680	171.416

TENSILE EXPERIMENTS.

(Laslett.)

Number of the Specimen	Dimensions of each piece	Specific Gravity	Weight the piece broke with	Direct cohesion on 1 square inch
	Inches		Lbs.	Lbs.
7	2 x 2 x 30	987	10.080	2.520
8	2 x 2 x 30	1006	13.440	3.360
Total		1993	23.520	5.880
Average		996	11.760	2.940

VERTICAL OR CRUSHING STRAIN ON CUBES OF TWO INCHES.

No. 9 Tons	No. 10 Tons	No. 11 Tons	No. 12 Tons	No. 13 Tons	No. 14 Tons	Total Tons	Average Tons	Ditto on square inch Tons
12.875	13.000	12.625	12.750	12.750	12.750	76.75	12.792	3.198

E = 296810 S = 1800

A recent paper (Oct. 29th, 1895,) by Prof. Maiden and J. V. DeCogne, goes into the question of piling resistant to cobra (teredo), they report great differences in the resisting powers of Jarrah in this regard. The paper is mainly on Turpine Timber vs. Toredo. The botanical name of this excellent tree is Syncarpia laurifolia, but it has not proved a reliable resistent to cobra.

E. melliodora—Yellow Jacket. Yellow box. Honey-scented. Timber hard, tough, durable in water and under ground. Heavy; not fissile. Good fuel, and for wheelwright and other uses—telegraph poles etc., —but not for planking. Color, yellow. Height 40 to 50 feet. Specific gravity, .965 to 1.125, or from 60 to 70 pounds per cubic foot.

EXPERIMENTS ON THE TRANSVERSE STRENGTH OF THE Wood of Eucalyptus melliodora, by Baron Mueller and J. G. Luehmann. The specimens were 2 feet long and 2 inches square.

Deflection		Total weight required to break each piece	Value of strength, $S = \frac{LW}{4BD^2}$	Specific Gravity	
With the Apparatus weighing 780 lbs.	At the crisis of breaking			Air dried	Absolutely dried
Inches	Inches	Pounds			
.06	.58	2903	2177	1.112	.947
.08	.63	2781	2086	1.040	.876

E. microcorys—Tallow-wood. Timber strong and durable above and below ground. Uses: Wheelwright and flooring, especially of ball rooms. Wood greasy, whence comes name. Color, yellow or yellowish brown. Height 100 to 120 feet.

E. microtheca—Black or Flooded Box, and other prefixes to boxwood. Very hard, heavy and elastic. Does well as piles and ties in railroad work and in building. Color, reddish to brown. A desert tree.

E. obliqua—Stringy bark, Iron Box, Messmate, straight and fissile, easily worked and so more generally used than other Eucalypti for building, fencing, scantlings, shingles, etc. Has a tendency to warp. Near base has beautiful wavy figure; very ornamental; color buff or light brown.

EXPERIMENTS ON THE TRANSVERSE STRENGTH OF THE wood of Eucalyptus obliqua, by Baron Mueller and J. G. Luehmann. The specimens were 2 ft. long and 2 in. square.

UNIVERSITY OF CALIFORNIA.

Deflection.		Total weight required to break each piece.	Value of strength, $S=\frac{LW}{4BD^2}$	Specific Gravity.	
With the apparatus weighing 780 lbs.	At the crisis of breaking			Air-dried.	Absolutely dried.
Inches.	Inches.	Pounds.			
.12	.50	2,053	1,540	1.045	.867
.14	.48	1,776	1,332	.935	.783

Subject like Jarrah and many other Eucalypti to defects due to kino veins.

E. occidentalis—Flat-topped Yate. Timber hard, heavy strong and durable. Uses—fences, sleepers, posts, fuel ; also wheelwright work. Height, 30 to 80 feet.

E. pilularis—Blackbutt. Also called Flintwood or Mountain Ash. Timber strong, durable, thoroughly safe and well tried. Uses—House building, bridges, planking, paving, etc. Prof. Maiden places this timber next to iron wood (Eucalyptus sideroxylon) and tallow-wood for general purposes. Next to Eucalyptus siderophloia it has endured a greater crushing strain than any other Eucalypti. Color generally pale or warm brown. Generally fissile, but occasionally refractory in this respect. Height 100 to 150 feet. Capt. Ward, R. E., found the deflection in a sample of this timber to be 1.35 inches, the material used being 4 feet long by 2 inches square, loaded in the middle with a weight of 980 pounds, while the elasticity remained unimpaired, breaking under a weight of 1,232 pounds. Specific gravity .990, (61 lbs. 14 oz. per cubic foot). Requires care in curing.

E. polyanthema—Red Box. Den tree. Great durability is attributed to this wood. It is one of the most sought for wheelwright work, cogs for wheels, supports in mines, etc. One of the best fuels. It is very tough and hard.

"Its hardness is against its general use"—(Maiden). Color, handsome red or reddish brown. Height 50 to 70 feet.

EXPERIMENTS ON THE TRANSVERSE STRENGTH OF THE wood of Eucalyptus polyanthema, by Baron Mueller and J. G. Luehmann. The specimens were 2 feet long and 2 inches square.

Deflection.		Total weight required to break each piece.	Value of Strength, $S = \frac{LW}{4BD^2}$	Specific Gravity	
With the apparatus weighing 780 lbs.	At the crisis of Breaking			Air-dried.	Absolutely dried
Inches.	Inches.	Pounds.			
.10	.56	3215	2411	1.248	1.031
.08	.58	3145	2359	1.214	1.010

Height occasionally up to 250 feet.
Victoria and New South Wales.

E. resinifera—Red or forest mahogany. Has been often confused with siderophloia in timber tests. Very strong, durable, hard and sound. Particularly free from shakes. Hard to work. Uses—piles, ships' knees, etc., posts and general building. Smooth grain. Color, dark red or brown. Height 80 to 120 feet.

E. robusta—White or swamp mahogany. Very durable, resists insect pests, not very fissile and very brittle. Uses—ship building, general building purposes, posts, etc. Color, reddish. Special gravity 1.098 air-dried ; .889 absolutely dry. A slab seasoned over 25 years weighed 58 pounds, 90 ounces to the cubic foot. Height 100 to 150 feet. 19 per cent. kino-red.

E. rostrata—red gum. Timber strong, durable, very hard when dry. Uses—piles, posts, especially in damp

ground; sleepers, bridges, ship building and for general purposes. Next to Jarrah the most durable of the gums. 16.62 per cent. Kino-red. Color, red—often very dark red, —curly and figured, takes a fine polish. Very handsome. One ton dried wood, 4 pounds pearl ash or 2½ pounds pure potash, (Mueller). Height up to 100 feet.

EXPERIMENTS ON THE TRANSVERSE STRENGTH OF THE wood of Eucalyptus rostrata var. (Dark Red Gum), by Baron Mueller and J. G. Luehmann. The specimens were 2 feet long and 2 inches square.

Deflection.		Total weight required to break each piece.	Value of Strength $S=\frac{LW}{4BD^2}$	Specific Gravity.	
With the apparatus weighing 780 lbs.	At the crisis of breaking			Air-dried	Absolutely dried
Inches.	Inches.	Pounds.			
.10	.65	2539	1904	1.045	.874
09	.68	2417	1813	.984	.809

Eucalyptus rostrata var. (Pale Red Gum)

Deflection.		Total Weight required to break each piece	Value of Strength, $S=\frac{LW}{4BD^2}$	Specific Gravity.	
With the apparatus weighing 780 lbs.	At the crisis of breaking			Air-dried	Absolutely dried
Inches.	Inches.	Pounds.			
.08	.52	2781	2086	1.008	.843
.07	.48	2712	2034	.940	.790

E. saligna—Blue gum, New South Wales. Straight grower, fine for spars; very heavy; rather subject to shakes; cross-grained; does not burn readily; durable. Uses—general, but not greatly esteemed. Color, red or warm brown. Wavy grain. Height 100 to 120 feet. Often confused in tests with botryoids.

E. siderophloia—White mahogany; also red iron-bark. "This timber has the highest reputation for strength and durability," (Maiden.) Very hard and heavy. Uses: General; especially good for beams in warehouses where great strength is required. Sought for spokes, ship-building, etc. Color, dark red or brown. Wavy grain. Specific gravity 1.15. Confused in tests with resinifera.

TRANSVERSE EXPERIMENTS.

(Laslett.)

Number of the Specimen	Deflections			Total Weight required to Break each Piece	Specific Gravity	Weight Reduced to Specific Gravity, 1000	Weight Required to Break 1 Square Inch
	With the Apparatus Weighing 390 lbs.	After the Weight was removed	At the crisis of Breaking				
	Inches	Inch	Inches	Pounds			Pounds
1	.85	.0	3.75	1460	1163	1255	365 0
2	1.00	.0	3.50	1370	1146	1195	342.5
3	.90	.0	4.00	1400	1142	1226	350.0
4	1.00	.0	4.00	1400	1116	1254	350.0
Total	3.75	.0	15.25	5630	4567	4930	1407.5
Average	.94	.0	3.812	1407.5	1142	1232	351.9

No. 1—Wiry fracture, 16 inches in length.
" 2— " 12 " "
" 3— " 10 " "
" 4—Broke short to one-third depth, then splintery fracture, 10 in. in length.

TENSILE EXPERIMENTS.

(Laslett.)

Number of Specimen	Dimensions of each piece	Specific Gravity	Weight the piece broke with	Direct cohesion on 1 Square Inch
	Inches		Pounds	Pounds
5	2 x 2 x 30	1142	34,160	8,540
6		1146	26,880	6,720
7		1163	39,480	9,870
Total		3451	100,520	25,130
Average		1150	33,507	8,377

VERTICAL OR CRUSHING STRAIN ON CUBES OF TWO INCHES

No. 8 Tons	No. 9 Tons	No. 10 Tons	No. 11 Tons	Total Tons	Average Tons	Ditto on 1 Square Inch Tons
18.500	17,625	18.500	19.000	73.625	18 406	4.601

E = 960740 S = 3695

E. sideroxylon—Ironbark. Straight bole. High reputation for strength and durability (Maiden). One of the hardest and heaviest of Australian woods, durable. Uses: Piles, bridges, poles for drays, large beams, etc. Average weight, 75 to 78 lbs per cubic foot green; loses 3 to 5 lbs in first two years drying; subject to shakes, difficult to dress, fine fuel; color rich red or dark red, sometimes brown. Sp. gravity, 1.176. Height up to 200 feet.

TIMBER EXPERIMENTED UPON BY THE VICTORIAN TIMBER BOARD, 1884.

The samples tested were each 7 feet in length by 1⅞ inches square; the distance between the bearings was 6 feet; and the weight was gradually applied in the centre until the sample broke.

Botanical Name	Locality Where Grown	Approximate Date when the Timber was Cut	Date of Testing	Weight of each Sample in lbs	Average Weight of Samples in lbs	Average Weight per Cubic Foot in lbs	Average Specific Gravity	Breaking Weight of of each Sample in cwts qrs lbs	Average Breaking Weight of Samples in lbs	Deflection at Point of Rupture in Inches	Average Deflection in Inches	Average Specific Strength	Geological Formation Where the Trees Grew	Elevation above Sea-level
Eucalyptus leucoxylon, F.v.M. Eucalyptus sideroxylon A. Gunn.	Toongabbie, Gippsland	1872	24-4-84	13¼	12,52	73.26	1.173	9.0.26	951.67	4	4.44	2598	Lower Palæozoic	A few hundred teet
			24-4-84	13				8,2,26		4⅜				
			24-4-84	12⅜				8.0.24		4				
			24-4-84	12				8,3,0		5½				
			24-4-84	12⅜				8,1.20		5				
			24-4-84	12⅛				7.2.14		3¾				

E. Stuartiana—Apple scented gum. Hard and durable and well spoken of for underground work; also spoken of as poor. Not easily split. Uses: Fence posts, planks, sleepers, etc. Takes a polish well. Color, wavy brown or red. Height, 60 to 90 feet. Specific gravity 1.010 air dried.

E. tereticornis—Red gum; also called grey gum, blue gum and flooded gum. Timber practically same as rostrata.

E. viminalis—Manna gum; also white gum. Reputation of timber poor; not so durable as other Eucalyptus that are much used. Used for fences, shingles and generally in building; center or heart wood no use. Color, pale. Height, 320 feet. Specific gravity .954.

SOME ABORIGINAL AUSTRALIAN AND VERNACULAR NAMES OF SPECIES OF EUCALYPTUS.

It will be noticed by this list that vernacular names, with very few exceptions, are confused and uncertain. Each distinct district in Australia has a nomenclature of the Eucalyptus more or less individual. In cases where I had information as to the district in which a name was current I have added the district after the scientific name.

A

Apple-scented Gum—E. Stuartiana.
Arang-nulta—E. tereticornis.
Ash, Morton Bay—E. tessellaris.
Arang-Mill—E. terminalis.
Ash-Mountain—E. pauciflora, E. amygdalina, E. pilularis (N. S. W.), E. Siberiana (N. S. W.), E. Stuartiana.
Ash, Mountain Black—E. sideroxylon, E. goniocalyx, E. Sieberiana.

B

Ballook—E. globulus (Gippsland).
Bangalay—E. botryoides (N. S. W.)
Barroul—Goura. E. tereticornis.
Benaroon—E. pilularis (N. S. W.)
Bembill—E. populifolia.
Biall—E. rostrata.
Binnak—E. botryoides (East Gippsland).
Binnap—E. viminalis (Victoria).
Blackbutt—E. haemastoma, E. patens, E. pilularis, E. piperita.
Black Gum—E. stellulata.
Black Sallee—E. stellulata.
Blood Wood Tree—E. corymbosa, E. paniculata, E. trachyphloia.
Blood Wood, Mountain—E. eximia.
Blue Gum—E. globulus, E. goniocalyx, E. haemostoma, E. megacarpa, E viminalis (western N. S. W.), E. rudis, E. saligna, E. botryoides, E. tereticornis. E. leucoxylon, E. diversicolor, E. rostrata (Sydney).

Boona—E. corymbosa (Queensland).
Brown Gum—E. robusta.
Box—E. hemiphloia, E. largiflorens, E. viminalis, E. microtheca, E. odorata.
Box, *Bastard*—E. goniocalyx, E. punctata, E. largiflorens, E. microtheca (N. S. W), E. tereticornis, E. polyanthema.
Box, *Bembil*—E. populifolia.
Box, *Black*—E. largiflorens, E. microtheca (Queensland), E. obliqua, E. stellulata, E. Stuartiana (Queensland.)
Box, *Broad-leaved*—E. acmenoides.
Box, *Brown*—E. polyanthema.
Box, *Dwarf*—E. microtheca.
Box, *Flooded*—E. microtheca (Gulf of Carpentaria.)
Box, *Gray*—E. goniacalyx, E. polyanthema, E. largiflorons, E. saligna (N. S. W.)
Box-Gum Topped—E. hemiphloia.
Box, *Iron-Barked*—E. obliqua.
Box, *Narrow-Leaved*—E. microtheca.
Box, *Poplar*—E. populifolia.
Box, *Red*—E. polyanthema, E. populifolia.
Box, *Shining*—E. populifolia.
Box, *Thozet's* E. Ravertiana.
Box, *White*—E. hemiphloia, E. odorata, E. populifolia.
Box, *Yellow*—E. melliodora, E. largiflorens.
Brittle Gum—E. hæmostoma. Variety micrantha.
But But—E. Stuartiana.

C

Cabbage Gum—E. Sieberiana.
Callaille—E. microtheca.
Canary Wood—E. hemiphloia.
Carbeen—E. tesseloris.
Creek Gum—E. rostrata (Western N. S. W.)
Cider Gum—E. Gunnii.
Cooly Bah—E. microtheca.
Cooburn—E. largiflorens.
Corang—E. tessillaris.
Crimson Flowered Gum—E. ficifolia.

D

Dadangba—E. robusta.
Dargan—E. melliodora.
Den—E. polyanthema.
Desert Gum—E. gracilis.
Drooping Gum—E. pauciflora, E. viminalis.

E

Easip—E. leucoxylon.
Egola—E. populifolia (N. Queensland).

F

Fat Cake—E. leucoxylon.
Fever Tree—E. globulus.
Forest Gum—E. rostrata (Queensland).
Flooded Gum—E. discipiens. E. rudis, E. saligna. E. tereticornis, E. Gunnii (S. W.), E. pauciflora, E. rostrata.
Flint Wood—E. pilularis.
Fluted Gum—E. salubris.

G

Giant Gum—E. amygdalina.
Gimlet Gum—E. salubris.
Goborra or Gobboro—E. microtheca (Western N. S. W.)
Guorpin—E. robusta.
Gray Gum—E. crebra, E. Raveretiana, E. saligna, E. tereticornis, E. resinifera, E. punctata, E. stuartiana, E. viminalis (Sydney,)
Green Gum—E. stellulata.
Gum Top—E. Sieberiana.
Gunnung—E. robusta, (N. S. W.)

H

Hickory—E. punctata, E. resinifera.

I

Ilumba—E. tessellaris.
Iron Bark—E. crebra, E. sideroxylon, E. paniculata, E. siderophloia, E. Sieberiana, E. resinifera, E. largiflorens. E. macrorryncha (McAllister River.)
Iron Bark. Broad-leaved—E. siderophloia.
Iron Bark, Lemon-scented—E. Stageriana (Queensland).
Iron Bark, Narrow-leaved—Red, white or grey—E. crebra.
Iron Bark, Red—E. paniculata (N. S. W.)
Iron Bark, Red, Flowered—E. sideroxylon.
Iron Bark, She—E. paniculata.
Iron Bark, Silver-leaved—E. pruinosa, E. melanophloia.
Iron Bark, White—E. paniculata.
Iron Gum—E. Raveretiana.

J

Jarrah—E. marginata.
Jerrile—E. marginata.
Jimbul Kurleah—E. microtheca (N. Queensland).
Jimmy Low—E. resinifera.
Jundere—E. acmenoides (N. S. W.)

K

Kangara—E. citriodora.
Karri—E. diversicolor.
Kimbarra—E. robusta (Queensland.)
Kino—E. resinifera, E. siderophloia.
Kurra-Gurra—E. hæmostoma (Queensland.)
Koloneu—E. microtheca (Queensland.)

L

Lead Gum—E. stellulata (N. S. W.)
Leather Jacket—E. punctata.
Lignum Vitæ—E. polyanthema.
Lemon-scented Gum—E. citriodora.

M

Maalok—E. obcordata.
Mahogany—E. marginata.
Mahogany Bastard—E. botryoides.
Mahogany Forest—E, microcorys, E. resinifera.
Mahogany Red—E. resinifera.
Mahogany Swamp—E. robusta.
Mahogany White—E. acmenoides.
Mallee—E. gracilis, E. oleosa, E. incrassata, E. uncinata. This scrub or brush growth is called by the natives Weir Mallee.
Mallee Ooldea—E. pyriformis (S. A.)
Manna Gum—E. viminalis, E. amygdalina (N. S. W.)
Messmate—E. amygdalina, E. piperita, E. obliqua, E. macrorryncha.
Mountain Apple—E. goniocalyx.
Mountain Gum—E. tereticornis.
Morrel—E. macrocarpa.
Muzzle Wood—E. stellulata.
Mungurra, or *Mungara*—E. tereticornis (N. S. W.)

N

Nankeen Gum—E. populifolia (N. A.)
Narulgun—E. hemiphloia.

O

Ooragmandee—E. fœcunda.

P

Peppermint—E. Stuartiana, E. amygdalina, E. piperita, E. viminalis (Victoria), E. odorata, E. capitellata, E. microcorys (Queensland.)

Peppermint, Narrow-leaved—Brown or White. E. amygdalina.

Poplar-leaved Gum—E. polyanthema.

Red Gum—E. rostrata, E. melliodora (Victoria), E. odorata (S. A.), E. punctata, E. calophylla, E. tereticornis, E. resinifera, E. Stuartiana (Tasmania), E. amygdalina (Victoria), E. Gunnii (N. S. W.)

Red Wood—E. piperita.

Ribbony Gum—E. viminalis (Southern N. S. W.)

River Gum—E. rostrata (N. S. W. and Queensland.)

Rushy Gum—E. eximia.

S

Salmon Barked—E. salmonophloia.

Sallee—E. stellulata.

Scarlet-Flowered Gum—E. miniata, E. phœnicea.

Scribbly Gum—E hæmastoma.

Silky Gum—E. saligna (N. S. W.)

Spear Wood—E. doratoxylon.

Slaty-Gum—E. largiflorens, E. tereticornis (N. S. W.)

Spotted Gum—E. maculata, E. goniocalyx, E. hæmostoma, E. capitellata (New England district of N. S. W.)

Stringy Bark—E. obliqua, E. capitellata, E. macrorryncha, E. piperita, E. tetrodonta, E. amygdalina (N. S. W.), E. acmenoides (Queensland), E. Baileyana, E. pilularis, E. Sieberiana, E. Stuartiana.

String Bark Silver-leaved—E. pulverulenta.

Stringy Bark White—E. piperita, E. eugenioides, E. capitellata.

Sugar Gum—E. corynocalyx, E. Gunnii (S. E. Australia.)

Swamp Gum—E. Gunnii, E. amygdalina, E. rudis, E. pauciflora, E. viminalis.

T

Tallow-Wood—E. microcorys.

Tcheergun—E. pilularis (Queensland).

Tanderoo—E. siderophloia (Queensland).

Tangoon or Targoon } E. microtheca.

Tea Tree—E. Stuartiana (Queensland).

Tee—E. microcorys.

Tewart, Touart, Tooart } E. gomphocephala.

Tjellat—E. tereticornis.
Toi—E. pilularis (Queensland).
Turpentine—E. pulverulenta, E. microcorys, E. punctata, E. Stuartiana.

U

Urara—E. citriodora.

W

Wandoo—E. redunca.
Wangara—E. amygdalina.
Wanguarra—E. obliqua.
Wangee—E. microcorys.
Weeping Gum—E. pauciflora (Tasmania), E. viminalis (N. S. W.)
White Gum—E. amygdalina, E. goniocalyx, E. haemostoma, E. leucoxylon, E. paniculata, E. pauciflora, E. redunca, E. populifolia (Queensland), E rostrata (S. A.), E. saligna, E. viminalis, E. gomphocephala, E. Gunnii.
White Top—E. pilularis (N. S. W.)
Willow—E. pilularis (N. S. W.)
Woollybutt—E. longifolia, E. botryoides, E. Raveretiana, E. viminalis, E. Sturtiana (N. S. W.)
Woolgook—E. obliqua (Victoria).

Y

Yandee—E. foecunda.
Yangoora—E. macrorryncha, E. capitellata, E. piperita.
Yarrah—E. rostrata (Western Interior).
Yate or Yeit—E. cornuta.
Yate—Flat-topped—E. occidentalis.
Yathoo—E. microtheca.
Yellow Blood Wood—E. eximia.
Yellow Gum—E. Gunnii, E. punctata.
Yellow Jacket—E. ochrophloia, E. peltata, E. rostrata (Queensland).
Yerrick—E. sideroxylon (Gippsland).
York Gum—E. foecunda (E. loxophleba).
Yownt—E. Sieberiana.

The vernacular names current in California for species of the Eucalyptus are as follows:

Blue gum—E. globulus only.
Manna gum—E. viminalis.
Red gum—E. rostrata, E. tereticornis, and, in error, E. viminalis, E. occidentalis, E. resinifera.
Sugar gum—E. corynocalyx.
Yate—E. cornuta.

EUCALYPTUS OILS.

The use of Eucalyptus oils is constantly increasing in medicine and yet the marked differences in the oils derived from different species of Eucalyptus does not seem to have been realized by the physician or by the apothecary. Generally several species of Eucalyptus are recognized as reliable sources of medicinal oils; amongst these may be named Eucalyptus globulus and Eucalyptus amygdalina. The first of these contains about 60 per cent of Eucalyptol to which its medicinal value is attributed. The chemical formula of this is $C_{10} H_{16} O$. Eucalyptus amygdalina on the other hand contains but a trace of Eucalyptol, if any. It has a number of forms, the oils of which differ considerably from each other, all of them however have Eucalyptol replaced by Phellandrene. The chemical form of Phellandrene is $C_{10} H_{16}$. It is clear that whatever value Phellandrene may have in medicine it cannot be properly put in a prescription that calls for Eucalyptol or an oil containing it. The increased use of the Eucalyptus oils derived from the solid plantations of E. globulus in California and in Algiers is thus seen to rest upon reasonable grounds and must give increased reliability to medicinal preparations from the Eucalyptus. Eucalyptol is best recognized and known in its therapeutic effects, but Phellandrene is also known to have very similar effects and may be as good or better than Eucalyptol.

The different and in some cases contradictory reports I have seen on the Eucalyptus oils induced me to secure the aid of S. M. Woodbridge, Ph. D., in making some examinations of these oils taken from species identified here. I give the result of the doctor's work in his own words. I also reproduce a recent article by Prof. J. H. Maiden, taken from the *Chemist and Druggist* of Australasia, March, 1895. Samples of the Eucalyptus oils made by Dr. Woodbridge, will be placed in the Los Angeles Chamber of Commerce.

One of the results of Dr. Woodbridge's distillations has been to determine me in recognizing several species not recognized by Baron Von Mueller. Where in addition to bud, flower and fruit differences, as for instance, between Eucalyptus globulus and Eucalyptus Mortoniana, we have oil derived from the foliage almost at the extremes of difference in the genus in yield and character, we may well agree to recognize specific rank in each case. In other species while the difference in the oils is not so great it is still sufficiently marked to justify specific rank where now only forms or varieties are recognized. It was the oil that caused me to set up as a species Eucalyptus Californica from what was before deemed a form of Eucalyptus occidentalis. Eucalyptus Californica itself has two forms from only one of which could I obtain leaves for distillation and that the least attractive with a greenish yellow flower and more drooping habit. The beautiful Eucalyptus Californica with the crimson flower and so constantly in bloom at the Santa Monica Forestry Station, we have in only one tree.

Amongst the striking results of the Woodbridge distillation we may note the following:

Typical amygdalina gave 256.5 ozs. to the 1000 lbs. of

leaves. Eucalyptus amygdalina, var. regnans, gave 180.5 ozs., while the var. angustifolia gave but 148.7. The oil from the first was a clear yellow, while the other two were green but of different shades. While all these bear a distinctive pepperminty-Eucalyptus odor and taste they were markedly different from each other in intensity. The specific gravity of the first oil was at the extreme end of the line in lightness from that of the other two. Besides the three forms of amygdalina examined we have here two others quite as distinct in appearance. I have no doubt that the botanic individuality of several forms of amygdalina should be given specific rank if only from the deep-seated difference shown to exist by their oils.

Eucalyptus sideroxylon, var. pallida, contains 181.36 oz. of oil. Eucalyptus sideroxylon, with green foliage and white flowers, contains 146.6 oz., and is next to Eucalyptus Stuartiana, the heaviest of the Eucalyptus oils examined. Eucalyptus leucoxylon, formerly taking in Eucalyptus sideroxylon as a form, contains but 33.3 oz. of oil. Eucalyptus globulus contains 134.8 oz., and Eucalyptus Mortoniana, suggested to be a form of Eucalyptus globulus, contains but 10.90 oz.

The oils from Eucalyptus rostrata and Eucalyptus tereticornis appear to be as similar in character as they are in yield. This is in flat contradiction to the position of Schimmel & Co., as quoted by Maiden. The question then arises as to whether Schimmel & Co., had the oil of tereticornis. If they did we have no tereticornis here. The marked difference between rostrata and tereticornis is only in the bud according to what I can make out. The bud cap of tereticornis is like a candle snuffer or sugar loaf, while that of rostrata is drawn down to a beak-like form.

The accompanying plates of these two flowers can be studied. What I have recently noted in groves and plantations of rostrata is a tendency in the bud caps to vary toward the tereticornis form. The similarity of the oils suggests the possible propriety of reducing tereticornis to a form of rostrata.

Mr. Joseph Bosisto, one of the first and largest producers of Eucalyptus oil, of Victoria, Australia, gives the following as his experience in the yield of Eucalyptus oils from the various species.

From 1000 lbs. fresh leaves with their stalklets and branchlets.

Eucalyptus	viminalis	7 oz.
"	melliodora	7 "
"	rostrata	15 "
"	obliqua	80 "
"	globulus	120 "
"	goniocalyx	150 "
"	leucoxylon	160 "
"	oleosa (mixed with other species of mallee scrub)	200 "
"	amygdalina	500 "

Mr. Bosisto's leucoxylon is probably the present sideroxylon. Otherwise the marked differences are in Eucalyptus amygdalina, in which he doubles our highest yield; in Eucalyptus obliqua which he also doubles; and in Eucalyptus rostrata where he gets 15 oz. to our 55.54 oz., or about one-fourth of our yield. Such differences can not be plausibly attributed to differences in the season of the year when the foliage was gathered or to the soil or situation of the trees tried, although these points would doubtless become appreciable to some extent after study. Just indeed as oranges show differences in the yield and character of the fruit according to the condition and climate to which the

orchards are subjected, so also Eucalyptus oils from the same species in different places may be presumed to somewhat vary. But as a blood orange cannot be expected on a navel tree, nor a pomola grape fruit on a St. Michael, nor a lemon on any orange tree, so we could not get 15 oz. from 1000 lbs. of Eucalyptus rostrata leaves in Australia and 55½ oz. from rostrata in California. We assume that Mr. Bosisto did not have the foliage of rostrata, but that of some other tree.

The oil of Eucalyptus Staigeriana alluded to by Prof. Maiden has a very attractive oil containing citral. It is spoken of as the most delicately fragrant of the Eucalyptus oils. The tree seems to be quite unknown to Australian seedsmen. The habitat of this tree is in Queensland, I believe, on the Palmer River, though I have been unable to find or recall the authority for this statement. Dr. Woodbridge feels that only the door has been opened in his examinations on the specie characteristics of Eucalyptus oils.

EUCALYPTUS OILS.

BY S. M. WOODBRIDGE, PH. D.

Chemical authorities in technical works and encyclopedias have always divided the oils from the products of growth in two classes:

1. Fixed or fatty oils, and
2. Essential or volatile oils.

The fixed or fatty oils are described as follows: Characterized by their ability to communicate to paper and like substances a permanent translucent grease-spot, and they cannot be volatilized except by "destructive distillation" at high temperatures.

The essential or volatile oils are described as not being oleaginous to the touch and make no permanent grease-spot; they are distilled at various temperatures, *unchanged.*

Accepting these definitions as true, and it does not appear that they have ever been questioned, it is difficult to see how the oils of the various Eucalypti can be defined under either of the above classes. Of a large variety that have been tried all are unctious to the touch but leave no permanent grease-spot on paper nor does it require a "destructive distillation" to volatilize the greater portion of them, although the last portions of all of them that have been tried, require a "destructive distillation;" neither, on the contrary, do they volatilize at ordinary temperature nor volatilize at all *unchanged*, but a variety of products come over at different temperatures far above the boiling point of water, each of which has very different characteristics from the oil and from every other product obtained.

The Eucalyptus oil might be described as a "compound oil," some of the constituents of which volatilize at various temperatures with a residue that cannot be volatilized except by "destructive distillation."

The Eucalyptus oils of commerce are obtained from the leaves of the different varieties of Eucalyptus, by distillation in an ordinary still and condensing coil. The best results were obtained when the steam pressure in the boiler was maintained at not less than eighty pounds, and when the leaves were put in the still loosely in such a way that they could not pack down. Repeated trials show that by crowding the still a loss of between twenty-five and twenty-eight per cent. resulted; i. e., less oil would come over when the leaves were packed in the still, or allowed by their own weight to pack down. This packing of the leaves can be avoided by putting in a layer of leaves, say, one foot in thickness, then a porous frame or lattice rack made to rest on the sides of the still or cage. On this frame or rack another layer of leaves could be placed, and on these another frame, and so on, until the cage or still was filled. The reason for this want of recovering all the oil in a closely packed still will be readily understood when it is considered that the oils are non-volatile at the temperature of the steam within the still, but are taken up mechanically by the steam and carried over with it. The pressure in the still never exceeded fifteen pounds, therefore the heat could not have exceeded 248 degrees, F., a temperature at which only a very small portion of oil will volatilize.

The following table will show the amounts of oil yielded by some 26 varieties of Eucalyptus, together with their specific gravities and colors:

No.	EUCALYPTUS.	Amount of Oil in 1000 lbs leaves Av. Oz.	Specific Gravity	Color
1	Amygdalina	256.5	.878	Clear, yellow tinge
2	Amygdalina Regnans	180.5	.9163	Nile green
3	Amygdalina angustifolia	148.7	.9149	Greenish tinge
4	Sideroxylon, var. pallida	181.36	.9176	Nile green
5	Sideroxylon	149.6	.9211	Dark olive green
6	Globulus	134.8	.9143	Light greenish yellow
7	Occidentalis	101.4	.9146	Light yellow
8	Occidentalis Californica	95.8	.9113	Light yellow greenish tinge
9	Citriodora	80.52	.8797	Water white
10	Pauciflora	67.17	.8792	Light lemon gr'n
11	Rostrata	55.44	.8942	Amber
12	Diversicolor	54.18	.913	Lemon yellow
13	Tereticornis	51.34	.892	Deep yellow
14	Obliqua	46.34	.8912	Port wine
15	Stuartiana	39.17	.9239	Bistre
16	Leucoxylon	33.3		
17	Botryoides	31.13		Sap green
18	Macrorrhyncha	19.5		
19	Cornuta	27.1		Olive yellow
20	Mortoniana	10.90		Light emerald green
21	McClatchiei	12.15		Dark emerald green
22	Viminalis	11.5		
23	Calophylla	11.		
24	Rudis	Nom. only		
25	Siderophloia	" "		
26	Gunnii	None		

A mere glance at the above table will show how very different in color, specific gravities, and amounts of yield the different varieties of Eucalyptus are and the characteristic odors are as diversified as their other points, indeed they are so different that it might be possible to identify the variety by its oil.

The variety Gunnii yielded no oil, but during distillation, an non-condensible vapor came over, which had a temperature of 58 degres, F., and filled the room with the characteristic odor of bitter almonds.

Of all the twenty-six varieties distilled, but seven or eight seem to yield sufficient oil to pay for extracting and the maufacturer should see to it that other varieties of leaves are not allowed to be mixed with these varieties when buying. Indeed, only one variety of leaves should be placed in the still at one time; this rule should be carried out until such time as the value of each variety of oil could be determined.

Re-distillation.

With the single exception of citriodora oil, it is necessary to re-distill Eucalyptus oils and they all carry some trace of their original color with them. If, however, they are re-distilled with from three to four times their weight of water, always using the water of distillation from first distillation and one part in forty of caustic potash of the best quality, such as Babbit's, a water white oil can be obtained.

On partial distillation of the Eucalyptus globulus about 4 per cent. comes over at a temperature below 170 degrees C., from 57 to 60 per cent. comes over between 175 and 180

degrees C., and twenty-four to twenty-six per cent. from 180 to 230, after which a "destructive distillation" begins.

In making a series of re-distillations and partial distillations, Mr. E. M. Wade, gave his very valuable assistance and it is cause for regret that neither time nor opportunity has enabled us to decide what were the different products of these partial distillations with the single exception of that portion of the oil which came over between 175 and 180 degrees, which is Eucalyptol, but we cannot agree with the authority which follows, that it crystallizes at a temperature of one degree C., or at any other lower temperature.

THE CHEMISTRY OF THE AUSTRALIAN INDIGENOUS VEGETATION.

PRESIDENTIAL ADDRESS OF M. J. H. MAIDEN, F. C. S., F. L. S., &c., PRESIDENT OF SECTION B. CHEMISTRY, &c.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(Cineol is the same as Eucalyptol K.)

EUCALYPTUS OIL.

The scientific investigation of individual Eucalyptus Oils is in a very incomplete state, and from the special circumstances connected with them, Australian chemists possess peculiar advantages for their examination. They afford a peculiarly tempting subject for research.

The Oleum Eucalypti of the B. P. of 1885 is defined as "the oil distilled from the fresh leaves of *Eucalyptus globulus* Labill., *Eucalyptus amygdalina*, Labill., and probably other species of *Eucalyptus*.

"*Characters and Tests.*—Colorless or pale straw-colored, becoming darker and thicker by exposure. It has an aromatic odor, and a spicy and pungent flavor, leaving a sensation of coldness in the mouth. It is neutral to litmus paper. Specific gravity about 0.900. Soluble in about an equal weight of alcohol."

The unsatisfactoriness or this definition is recognized by the British Pharmaceutical Conference, for in question 14 (1894 meeting) it is stated:

—"Ol. Eucalypti B. P., a more precise definition of this oil is required." I very much regret that the researches on the numerous substances known as eucalyptus oil are not sufficiently complete to be available to the Committee appointed to prepare the new Pharmacopœia. Whatever decision may be arrived at as regards standards for this oil must necessarily be based on imperfect information.

Without taking note of well-marked varieties there are in Australia about 150 different kinds of eucalypti. A large number of these yield oil, or are capable of yielding it commercially; even yet, with all the work that has been lavished on them, we have no accurate knowledge of 10 per cent. of these oils. We have accurate (and more or less complete) knowledge of those of *Eucalyptus globulus*, Labill., *Eucalyptus amygdalina*, Labill., *Eucalyptus cneorifolia*, *Eucalyptus maculata*, var. *citriodora*, and meagre knowledge of a few others. Why? Mainly because of the difficulty of obtaining authentic material for research, except from stills situate in the midst of a forest of *Eucalyptus* of one species and no other. I am perfectly certain from my own tests, and from my botanical knowledge of the districts from which oils labelled in a particular way were obtained, that the oils of many workers are often mixed oils. In adding to my collection of oils for research I have endeavored to call in the aid of distillers in different parts of the country, with the view to have the stills charged with one kind of leaves and no other, but the owners are often very suspicious, and their oils are not to be relied upon for research work. Amongst what I may call educated distillers, very few are willing to submit their oils to the research analyst.

I have bought a large number of oils in open market and have acquired other oils under special circumstances, but as regards the oils of many species, I find my only course is to distil them myself. The still is under construction in the Technical College, and I have made arrangements to send my own collector to collect leaves botanically true. I thus begin on the bed-rock, just as I have with gums, tans and timbers. My only regret is that from the nature of things, the research must be protracted. Meantime, I have a good deal of material to work upon, more in fact than I can get through with in a considerable period with the present demands on my time. In this connection I would point out that if country pharmaceutical chemists have neither the time nor the inclination for research work on Eucalyptus oils, they could do yeoman service in the matter by supervising the distillation of Eucalyptus oils true to name for research purposes.

Eucalyptus globulus. Labill.—This is a Tasmanian and Victorian tree which is practically unknown in the other colonies to the average citizen. It has been largely planted in other countries, and so often written about that many people—even in these colonies—think that there is but one *Eucalyptus*, and its name is *globulus*. In other words, that

Eucalyptus and *globulus* are convertible terms. This accounts for the preponderance of the literature of *Eucalyptus globulus*. At the same time *Eucalyptus globulus* is an oil which may readily be obtained in a state of purity, so that the researches of Schimmel, Wilkinson, and other modern workers referring to it may be relied upon.

This oil is largely in favor in Europe. The Eucalyptus plantations of Algeria now yield a considerable quantity of oil, and there is a tendency to supplant the oil produced by the native country of the species. I observe that Schimmel & Co., guarantee 60 per cent. of Cineol in their oil and absence of Phellandrene, "which latter constituent is present in Australian oil." *

Schimmel gives the percentage of yield of oil from raw material from 1.6 per cent. In Gippsland the usual percentage is perhaps 1.25 to 1.5. The same firm† also gives the sp. gr. at 15 deg. C. at from .91 to .93. A complete analysis shows the presence of Valeraldehyde, Butyraldehyde, Capronaldehyde, and Pinene, in addition to Cineol. Optical rotation, 1 deg. to 20 deg. Wilkinson gives the specific gravity from .89 to 95. Usually it is well over .9, readily satisfying the requirements of the B. P. in this respect.

* *Bericht*, October, 1893.
† *Bericht*, October, 1893, p. 19.

Eucalyptus amygdalina, Labill.—This tree, which principally goes under the name of "Peppermint" of one sort or another, is found in Tasmania, Victoria, South Australia and New South Wales, being more widely distributed in the last colony than it was supposed to be. It is not only very abundant but it grows to a very large size, and its oil yield is comparatively great (2 to 3 per cent.) We know very little yet of the variation in the oils of the Eucalyptus caused by different circumstances of habitat, size and season of growth of the trees. My experiments with *amygdalina* tend to show that its specific gravity is low (say from .862 to .885 in ordinary samples); it contains but little Cineol, and an overwhelming proportion of Phellandrene. I observe, however that Wilkinson * gives the specific gravity of oil of this species (taking only two decimals) at .85 to .89, and from .91 to .96 (a blended oil.)

* *Proc. R. S*, *Vict.* 2, vi. 197.

E. amygdalina is very largely sold in Australia under the generic term of "Eucalyptus Oil," but it is also a great deal used for blending, so that I doubt whether much arrives in England in the pure state. In fact blending is a good deal more resorted to than is usually imagined.

Schimmel & Co. state that the oil of *Eucalyptus crebra*, and *E. hemiphloia* are very rich in Cineol.* The former is the narrow-leaved "Ironbark" and the latter is "Grey Box." Both trees are very abundant, and should be tested for oil yield. The same firm also state that the oil

of *E. microcorys*, F. v. M. (Tallow Wood) contains Cineol, has a sp. gr. of .935, and boils between 160° and 200° .† Staiger states that the leaves yield about 2 per cent. of oil, and I certainly think that this is a species which should be carefully tried by the distiller. *E. odorato*, Behr (sp. gr. .907), containing Cuminol in addition to Cineol, should also be tried. Schimmel also states that *E. populifolia*, Hook, contains "a fair proportion of Cineol. I have recently examined the oil *E. pulverulenta* (Argyle Apple), which has not been previously described. It is of a bright green color, like Cajeput, has a specific gravity of .9145 at 23 degs. C, gives excellent results for Cineol, and shows only the slightest indications of Phellandrene. When re-distilled, aldehydes commence to come over at 110 deg. C. and between this and 171 deg. C., when the temperature becomes stationary, 10 per cent. has distilled over. An additional 85 per cent. comes over between 171 degs. and 195 degs. This distillate is a very good oil, only showing a slight tinge of green, is rich in Cineol and almost free from Phellandrene. It has a sp. gr. of .912 at 25 degs. C. This oil is very full of promise, and I intend to further examine it.

**Bericht*, April, 1893, p. 38.
†*Ib.*, Oct. 1893, p. 21.

Schimmel has examined the oil of *E. rostrata*, Schlecht.* (Murray red gum). Its sp. gr. at 15 degs. C. is .924, and optical rotation 12° 58'. Besides Cineol, it contains valeraldehyde. This species is worthy of proper practical tests. The same firm, however, find no Cineol in a Queensland sample of *E. tereticornis* oil. If this be confirmed it will be remarkable, considering the close botanical affinity of this and the preceding species.

**Bericht*, Oct. 1893, p. 21.

For practical purposes it is convenient to deal with the mallee oils separately. The vegetation of Kangaroo Island, South Australia, is mainly composed of a mallee—the "narrow-leaf peppermint" (*E. cneorifolia*)—and it yields an oil of high specific gravity and Cineol percentage, and contains little or no aldehyde. The oil of *E. dumosa* is also valuable. That of *E. oleosa* has been examined by Schimmel,* who pronounces it to contain both Cineol and Cuminol. Its sp. gr. at 15 deg. C. is .915 to .925, and optical rotation 3 deg. and 5 deg., Wilkinson.

Bericht, Oct., 1893, p. 21.

The term *oleosa* has, however, been sometimes used in a generic sense, and hence we cannot always guarantee that the oils labeled "oleosa" are the sole product of *E. oleosa*, F. v. M. There are other species of Mallee, but as some confusion has arisen in regard to their various products a monograph of Mallee oils would be invaluable.

Under the head of "Scented or Perfume Oils," that of *E. maculata*,

Hook., var. *Citriodora*, stands pre-eminent. It has contained as much as 95 per cent. of citronellon and 5 per cent. of geraniol. It is soluble in from 4 to 5 parts of 70 per cent. alcohol. One sample was optically inactive, another slightly dextrogyre. Boils between 209 deg. and 220 deg., sp. gr. .87 to .90,* but .87 to .88, according to Wilkinson.

The oil of the "Lemon-scented Ironbark" (*E. Staigeriana*) F. v. M. is even more sweetly scented. It is high in oil yield. Its sp. gr. at 15 deg. C. is .88, and it boils between 223 deg. and 233 deg. It contains Citral.† Owing to their volatile nature these oils have not been that commercial success it was hoped they would have been.

**Bericht*, October, 1893. †*Ib.*

Cineol (*Eucalyptol*) is represented by the formula $C_{10} H_{16} O$. Its specific gravity is .930, and boiling point 176-177 deg. C. It is a colorless and transparent liquid, is optically inactive, and belongs to the Camphor Group. It crystallises at a low temperature (1 deg. C.), and this property enables it to be separated (by repeated crystallizations) in a pure state from mixtures containing it. In our warm climate the separation of crystallizable Cineol is attended with difficulty, particularly if it contain terpenes, for those bodies are solvent in Cineol. In fact the presence of Cineol in an oil rich in turpenes is very difficult to detect, and hence such oils have often been returned as containing no Cineol, when, as a matter of fact, they do contain it. There are certain chemicals tests for the detection of Cineol, but they are by no means easy of application.

It has been assumed, and it has been endeavored to prove, that Cineol is the only therapeutically active constituent of Eucalyptus oils. It is the practice of some to determine the value of Eucalyptus Oils simply according to the percentage of Cineol. But we must suspend our judgment in regard to Cineol being the only valuable constituent of Eucalyptus Oil. I am personally aware of beneficial effects which have attended the use (for inhalations, etc.) of oils which I have shown to practically consist of Phellandrene. Endeavors are made to completely replace Eucalyptus Oil in therapeutics by the pure body (Cineol). I do not dispute the therapeutic value of Cineol, and while I am fully aware of the advantage in therapeutics of dealing with a substance of defined chemical composition, it will be found impossible in practice to supplant the innumerable Eucalyptus Oils of all degrees of Cineol content, and some of which are nearly or entirely destitute of it.

Cineol has been included in the Pharmacopœia of the United States. Tests imposed, in addition to those indicated above, are that equal parts of Cineol and soda-solution shaken together, must not change in proportion of volume; also, the alcoholic solution must not alter the color of litmus-paper, nor assume a brown or violet color by the addition of a drop of solution of ferric chloride, showing absence of phenols.

Phellandrene.—This is one of the several free terpenes represented by the formula $C_{10} H_{16}$. It is capable of existing in two optical modifications, one turning the plane of polarized light to the left and the other to the right. It boils at about 170 degrees.

With many writers on Eucalyptus Oils, it is a veritable pariah amongst terpenes, its presence disqualifying a Eucalyptus Oil. Those who object to its presence look upon it as a mere diluent of Eucalyptus Oil, stating that it possesses no medicinal properties that are not possessed by the terpenes of the cheaper oil of turpentine. At the same time we have no direct evidence that the terpene phellandrene is not a therapeutically active constituent of Eucalyptus Oil. In some it is entirely absent, in most it exists in greater or less quantity. It my be readily detected in an oil if treated with a concentrated solution of sodium nitrate. If a few drops of glacial acetic acid be added to the mixture a copious formation of crystals of phellandrene nitrate (of a whitish color) ensues.

Aldehydes.—The pungent and irritating odor of the oils of some species is owing to the presence of aldehydes, and fortunately there is no real difficulty in removing them by rectification. These cough-producing substances should always be removed, and I have heard a curious reason why manufacturers retain them in some oils. It is that the public like a pronounced flavor; some "fire in the oil," in fact. But I hope that the taste of the public will become enlightened, for these aldehydes may cause most serious results in persons suffering from throat, bronchial, or lung troubles, while I know of no compensating value whatever.

At the same time there are some sweet-scented and non-injurious aldehydes, *e. g.*, citronellon, which forms so large a proportion of the oil of *E. maculata*, var. *citriodora*.

Various Eucalyptus oils contain other other constituents, but they are of minor importance.

NOTES AND CORRECTIONS.

Through a most unfortunate revision after I had last seen the proofs several errors have crept into the page speaking of those who have assisted in this work.

Prof. J. H. Maiden is not only a distinguished chemist but is also a leading botanist of Australia, but his botanical work was not alluded to. Prof. Maiden, F. L. S., F. C. S., etc., is curator of the technological museum, Sydney, consulting botanist to the Forest Department of New South Wales, and a well known and highly appreciated writer on Australian Economic Botany.

Dr. B. E. Fernow has an "n" instead of a "w" at the end of his name. I am somewhat indebted to the works of Prof. Tomasi Crudeli, and regret to see his name misspelled.

In line 28, page 25, the word "sort" should be "sport." On page 24 allusion is made to the use of Eucalyptus globulus in keeping boilers clean and free from incrustation. The foliage was at first used for this, but now we use the molasses-like black residue left after distilling the oil from the foliage.

The investigations of Prof. Maiden on the Eucalyptus kinos indicate that many of the statements previously made regarding the kino-contents of the wood of various species are inaccurate.

A number of typographical mistakes occur, some of which require correction. On page 182, No. 10, Eucalyptus buprestium is misspelled. On page 184, No. 4, Eucalyptus leucoxylon, there should be a description of Eucalyptus sideroxylon as a distinct species. This can be had by a reference to the account of that tree. On page 192, No. 50, Eucalyptus tereticornis is misspelled. On page 193 Eucalyptus Mortoniana, named for the present Secretary of Agriculture by me, should have a capital M.

Eucalyptus robusta sometimes has pink buds that are profuse and very striking, at other times stalklet, calyx and cap will be a cream white with a yellow tinting. Through a mistake this interesting tree has two allotments of space in the general description. The vigorous growth of Eucalyptus botryoides directly on the coast at Santa Monica during the period free from the trade wind has not enabled the young trees later to stand this wind as well as we had expected.

Prof. Maiden writes me that the reports of extreme height in the Eucalyptus are not now deemed reliable. He thinks that 350 feet is about the maximum height that can be attributed to any of them.

As information accumulates there is more and more indication for two species in the present viminalis. From Antelope Valley two trial plantations of this species have shown a very divergent power of frost resistance. This may turn out on examination to be due to the presence of the two forms. Mr. Gill says he also has noted the two forms

of Eucalyptus viminalis, the more spreading being found in the southwestern border of Victoria, while the whiter and more erect form is found in the mountain ranges, especially in those behind Adelaide. The specimens in the Antelope Valley are not yet matured enough for us to tell one from the other in our present lack of knowledge. No viminalis timber is spoken of as first quality, but it is by some called fair and by others worthless. These varying reports may be due to the different forms of viminalis producing timber of different values. The characteristic viminalis has nearly always three flowers to the umbel, as represented in Von Mueller's plate; but some of the rough barked forms here have six or seven flowers to the umbel, generally six. These may be mere sports. A careful examination of many smooth-barked viminalis now in bloom here shows them to have three flowers to the umbel. Further notes on blooming seasons of the Eucalyptus show them to be very irregular. Some notes on this point are added.

Calophylla and robusta, December, January and February. Calophylla entirely over February 8th. Robusta just going out of bloom. Cornuta, diversicolor and botryoides out of bloom, buds look as if they would be in about June. Amygdalina just coming in again; also citriodora, polyanthema, globulus and resinifera in full bloom. Sideroxylon blooming, viminalis and cornuta in bloom May 1st.

May 7th Sideroxylon, var. pallida, Stuartiana, citriodora, obliqua and tereticornis are all in full bloom. Some Calophyllas are in bloom while others have already the fruits hard and nearly mature.

A report was recently brought to me that the flowers of Eucalyptus tereticornis were fatal to bees. It was no

half way affair like the intoxication of the bee by the poppy, but death absolute. I have been observing bees in the blooms of Eucalyptus tereticornis since then and have failed to note any unpleasant effect on these busy bodies. At Dr. Wernigk's, in the Alhambra, there are a number of swarms of bees adjoining a grove of Eucalyptus. In this grove are both tereticornis and rostrata. Eucalyptus tereticornis is in full bloom and the bees visit it freely. In looking under the trees, on the bee line to the hives and at the entrance I found one dead bee. The bees and the trees have been at the Doctor's for a long time. During this period he has never noticed dead bees about his place. Chickens might have eaten the dead bees. The report, however, recalls the one from Riverside on Eucalyptus rostrata, its close ally, as an apicide. My observations then fail to confirm those of Dr. Woodbridge and Mr. Shorting at South Pasadena.

Dr. Woodbridge tells me that he saw about a dozen bees drop and die in a grove of Eucalyptus tereticornis and he presumes it was after visiting the flowers. The Doctor is a careful and reliable observer and we must therefore look out for both tereticornis and rostrata in bee territory. I visited the South Pasadena grove cited and observed great numbers of bees working on the profuse and beautiful tereticornis flowers. I saw none fall, nor did the bees appear to be in any way unusually affected. I found on the ground one dead bee. Again, chickens might account for this absence of dead bees. Mr. Shorting assures me that a large number of dead bees were on the road near this grove a few days ago. The largest and oldest groves of Eucalyptus tereticornis and of Eucalyptus rostrata in this State are at Elwood. Hon. Elwood Cooper informs

me that no unfavorable report has come to him on the effect of the flowers of these trees on bees. If the nectar from these trees is bad for bees it is difficult to believe that an observant and public-spirited citizen like Mr. Cooper would not have noted it in all the years he has had these trees about his estate. There are both domesticated and wild bees in plenty about Mr. Cooper's groves. No ill effects on these have been noted from the flowers of any Eucalyptus.

To make more sure, I have taken another half day under an Eucalyptus tereticornis located in a gorge of the Sierra Madre Mountains. Near the tree was a large bank of orange-colored mimulus and bushes of the bear berry or wild coffee. The mimulus was visited by a large wild bee suggesting the bumble-bee. This big bee did not visit any of the other neighboring flowers, neither did the honey bees visit the mimulus. The honey bees seemed especially fond of the small obscure greenish flowers of the wild coffee. Numbers of bees visited the freshly opened flowers of Eucalyptus tereticornis. No ill effects appeared, neither could I find any dead bees under this tree. In this case chickens were absolutely excluded as scavengers. Ants visited the older flowers and seemed to find something interesting at the base of the stamens. No ill effects were noticeable in the ants. It would appear probable, then, that the dead bees observed near the grove of tereticornis at South Pasadena came to their untimely end from causes independent of the flowers of Eucalyptus tereticornis.

One tree of Eucalyptus tereticornis at Dr. Wernigk's again shows the peculiar trait, frequent in the genus Eucalyptus, of different colored flowers on the same tree and

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even on the same branch. In this case about half the flowers were cream white, the other half were tinted with purple. The flower cap, calyx and stalklet of each flower was cream white with only a suggestion of purple on the cap of some.

The seedlings of Eucalyptus calophylla of the claimed scarlet flower are now up. These differ from our Calophylla in having a rounder leaf and of much darker color. The young growth, both leaf and stem, in this new form is a deep claret red. The stems of the common calophylla seedlings are green. These seeds were sent to me through the courtesy of T. F. Baumgardt, of Brisbane, Queensland. The seeds, however, did not come from that colony.

The excellent detail work in the botanical illustrations I owe to the artistic capacity of Mr. George Steckel of Los Angeles. The photographs from which these illustrations were made can be had from Mr. Steckel. The carbon prints are both beautiful and accurate.

Mr. Francis Shorting is the first man of whom I have information to polish and prepare for use the seed vessels of Eucalyptus calophylla and Eucalyptus ficifolia for pipes.

Recent reports from Bakersfield and its surrounding districts make a striking showing of the disappearance of the old malignant malarial fevers since and during the large plantings of Eucalyptus.

There are two cuts of Eucalyptus polyanthema. They indicate a tendency to differentiation in this tree or perhaps a distinct variety. The round leaf form is the most attractive looking but may not grow as fast as the more narrow leaved form.

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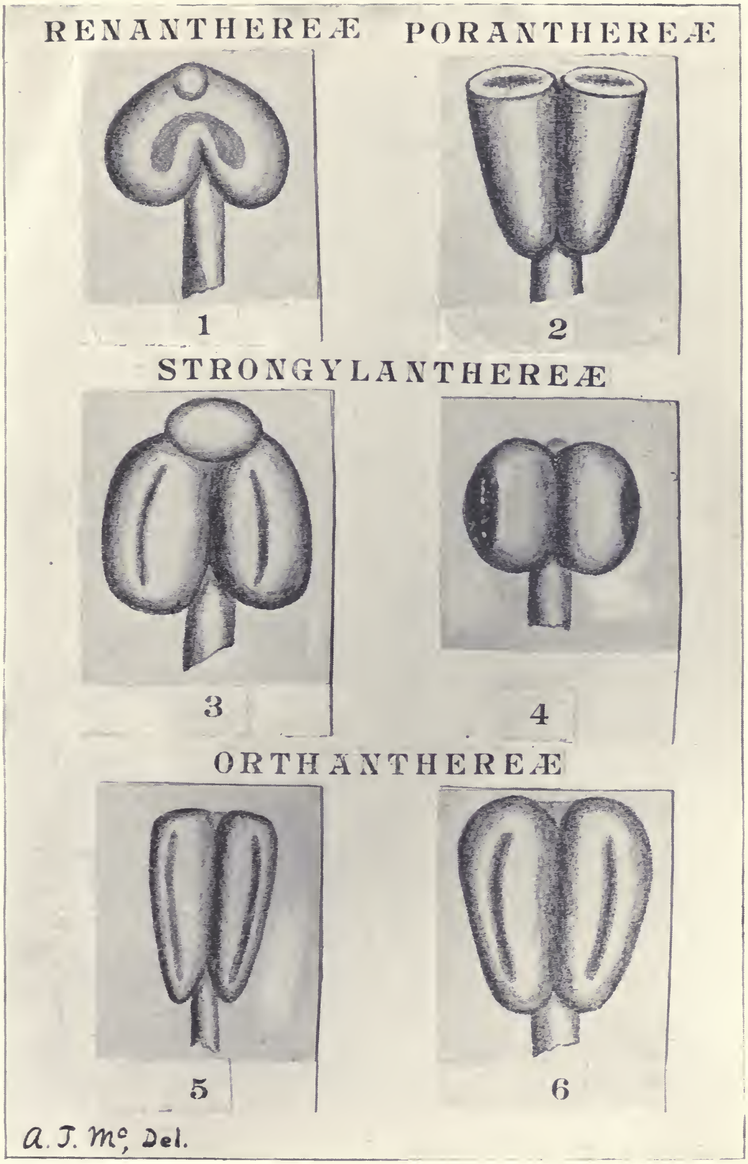

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2—E. POLYANTHEMA.	4—E. SIDEROPHLOIA.	6—E. GUNNII.

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E. GLOBULUS,

With young opposite leaves, and the sickle shaped alternate leaves taking possession.

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E. GLOBULES—In a Pasadena Garden.

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AVENUE OF E. GLOBULUS, SOUTH OF LOS ANGELES.
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E. STUARTIANA, WITH PROF. A. J. McCLATCHIE.

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